PAGE'S WEEKLY.—January 26, 1906. Thin Paper Copy for Circulation Abroad.

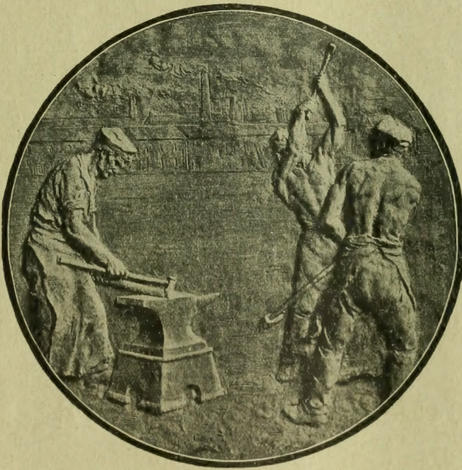
No. 72. Vol. 8.

SIXPENCE.
(Registered as a Newspaper.)

FRIDAY,
JANUARY 26, 1906.

PAGE'S WEEKLY

LIBRARY
FEB [illegible] 1906
UNIVERSITY OF TORONTO



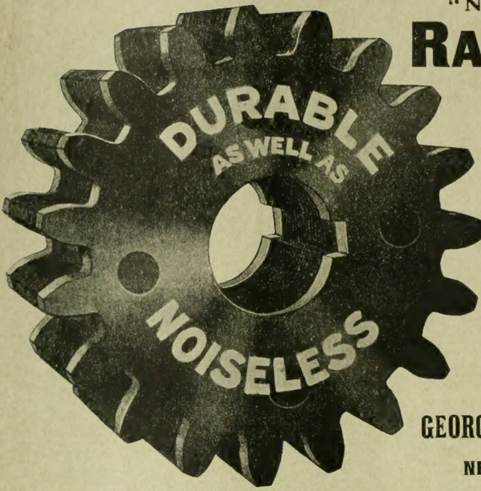
ENGINEERING · ELECTRICITY SHIPBUILDING MINING IRON & STEEL INDUSTRIES

EDITORIAL & PUBLISHING OFFICES, CLUN HOUSE, SURREY STREET, STRAND, LONDON, W.C.

France, Paris : 22, Rue de la Banque.
Germany, Berlin : 13, Unter den Linden.
Russia, St. Petersburg : 14, Nevsky Prospect.
Italy, Rome : 307 Corso.
Austria, Vienna : Kärntnerstrasse, nr. 30.

India, Calcutta : Thacker, Spink & Co.
" Bombay : Thacker & Co., Ltd.
South Africa, Cape Town : Gordon & Gotch.
Japan, Yokohama : Kelly & Walsh, Ltd.
New Zealand : Gordon & Gotch, Ltd.

Canada : Montreal News Company.
United States, New York : International News Co.
" Chicago : Subscription News Co.
Australia, Melbourne : Gordon & Gotch.
Straits Settlements, Singapore : Kelly & Walsh, Ltd.



"NEW PROCESS"

RAW HIDE GEARS.

All Teeth Cut to Brown & Sharpe's Standards.

ALSO METAL GEARS.

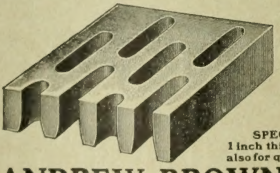
Send for Descriptive Catalogue.

GEORGE ANGUS & CO., Ltd.,
NEWCASTLE-ON-TYNE.

CYCLONE FANS FOR Induced Draught.

MATTHEWS & YATES, Ltd.,
Swinton, Manchester.

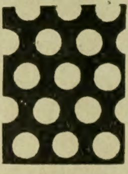
PERFORATED METALS OF ALL KINDS



MAKERS OF . .

- Filter Press Plates.
- Rotary Sifting Plates, etc., etc.
- Revolving Screens and Trommels, Black and Galvanized.
- Embossed Plates for Stair Treads and Locomotive Steps.
- Special Designs of Perforated Plates made exactly to drawings and up to one inch thick.

SPECIALITY.—Heavy Steel Plates up to 1 inch thick with narrow slots for crushing rolls; also for quarries, etc., in special hard quality steel.



ANDREW BROWN & Co., 110, CANNON STREET, E.C.

Sole Agents for FR. MEGUIN & CO., Ltd.

Telegraphic Address: "Browpost, London." Illustrated Catalogue Free. *Telephone*: 8168 BANK.

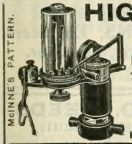
PAGE'S WEEKLY Miscellaneous

Mr. G. H. HUGHES, M.I.Mech.E.,

Consulting and Organising Engineer for Water Works and Industrial Undertakings,

19, OLD QUEEN ST., WESTMINSTER, S.W.

Telephone No.: 5754 Bank. Write for particulars



McINNES'S PATTERN.

HIGH SPEED INDICATORS.

Hannan & Buchanan,

75, Robertson Street, Glasgow.

ENGINE COUNTERS.

BOURDON GAUGES.

On Admiralty List.

Engineering Instrument Makers

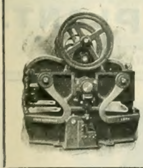
PATENTS.

Mr. J. G. LORRAIN, M.I.E.E., M.I.Mech.E., Fellow of the Chartered Institute of Patent Agents.

NORFOLK HOUSE, NORFOLK STREET, STRAND, LONDON, W.C.

"PATENTEES' HANDBOOK," post free on application, gives Full Information to Inventors and upon all the chief points of the Patent Law.

Telegrams: "Lorrain, London."



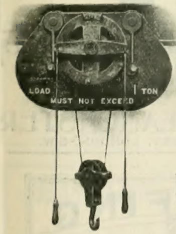
PUNCHING & SHEARING Machines.

STEAM HAMMERS.

Shipbuilders' MACHINE TOOLS.

DAVIS & PRIMROSE,

Leith Ironworks, EDINBURGH.



ELECTRIC . PULLEY . . BLOCKS . .

For 5 and 10 cwts., and 1, 2, and 3 tons.

Portable Electrical Drilling Equipments and Flexible Shafts.

KRAMOS, Ltd.,

Locksbrook Engineering Works,

BATH.

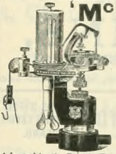
A. MOUNT-HAES,

M.I.Mech.E., M.I.M.E.,

Consulting and Mining Engineer for Ore Dressing Plants of All Classes.

II, IRONMONGER LANE, LONDON. E.C.

Tel. Address: "DRESSINGS, LONDON." Telephone No.: 272 Central.



'McINNES-DOBBIE' INDICATORS.

In Two types: External and Enclosed Pressure Springs.

Each made in several forms and sizes to suit all speeds and pressures.

Special Indicators for Gas, Winding, and Ammonia Engines, and for Motor-Cars.

DOBBIE, McINNES, LIMITED,

45, BOTHWELL ST., GLASGOW.

Adopted by the British, French, and Japanese Admiralties.

BABCOCK & WILCOX, Ltd.

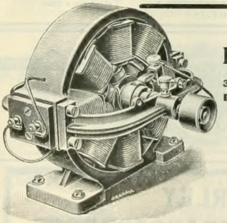
PATENT WATER-TUBE BOILERS.

These Boilers are in use throughout the world to the extent of 4,700,000 h.p. generating steam for all purposes, and fired with all kinds of fuel.

See our Advertisement appearing Feb. 16th, page 37.

HEAD OFFICES—Oriel House, Farringdon Street, LONDON, E.C.

WORKS—Renfrew, SCOTLAND.



The Crypto Electrical Co.,

3, Tyer's Gateway,
Bermondsey St.,
LONDON, S.E.

Makers of

DYNAMOS,

ALTERNATORS,

ETC.

Send for Catalogue.

COMPLETE INSTALLATIONS OF MODERN MACHINERY.

Catalogue E.

LAUNDRY MACHINERY

HILL & HERBERT, Ltd.

Laundry Engineers, **LEICESTER.**

FOR THE BEST BOOKS BEARING ON THE INDUSTRIES DEALT WITH IN "PAGE'S WEEKLY," viz., ENGINEERING, ELECTRICAL, IRON AND STEEL, MINING AND SHIPBUILDING, ASK FOR CATALOGUE, CHARLES GRIFFIN & CO., LTD., 12, EXETER STREET, STRAND, LONDON, AND SEE SPECIAL ADVERTISEMENT ALTERNATE WEEKS.

PAGE'S WEEKLY Miscellaneous

I WANT A POSITION
as your Advertisement Manager.
SALARY REQUIRED 5/- PER ANNUM.
I will give my services FREE for the first month, if you will send a penny stamp to defray my travelling expenses.
The BRITISH ADVERTISER,
Queen Anne's Chambers, WESTMINSTER, S.W.

CAST-IRON
COLUMNS,
STANCHIONS AND GIRDERS.
Head, Wrightson & Co., Thornaby, Stockton-on-Tees.

WALTER SCOTT, LTD., LEEDS STEEL WORKS, LEEDS, ENGLAND.
MANUFACTURERS OF . . .
Rolled Steel Joists, Channels, etc.
Mild Steel Blooms, Billets, Slabs, Tinbars, Rounds and Flats.
Speciality: TRAMRAILS.

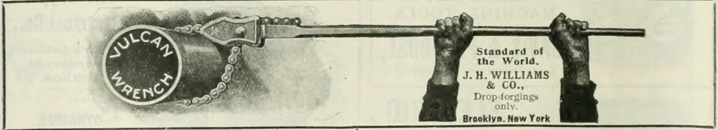
DESTRUCTORS and CLINKER MACHINERY.
Horsfall Destructor Co., Ltd., Armley, Leeds.
Telegrams: "DESTRUCTOR." Telephone: 2006.
Codes: A.B.C. (5th Edition) and Leiber's.

J. TOMEY & SON'S EUREKA GAUGE GLASS
ESTABLISHED 1853
ASTON
BIRMINGHAM.
A NEW GAUGE GLASS.
Samples, Lists, and Testimonials on application.
"S.H.P."
Tested to 350 lb. Steam Pressure.
For High Pressure Boilers.

STONE BREAKERS,
GRAVEL WASHERS, ETC.
SAMUEL PEGG & SONS, Engineers,
LEICESTER, England.
SEND FOR ILLUSTRATED CATALOGUE.

M. GLOVER & CO., LEEDS.
FIREWOOD & FIRELIGHTER MACHINERY SPECIALISTS,
FOR
SAW GUARDS, BENCHES, SHARPENERS.

BRETT'S PATENT LIFTER CO., LTD.
COVENTRY, ENG.
Speciality—
FORGING PLANT.
See our Advertisement appearing Feb. 16th.
SEND FOR LATEST CATALOGUE.



Standard of the World.
J. H. WILLIAMS & CO.,
Drop-forgings only.
Brooklyn, New York

TEMPERLEY TRANSPORTERS
For Rapid and Economical Handling of General Cargo, Coal, Ore, &c.
See our Advertisement in last week's issue.
TEMPERLEY TRANSPORTER CO.,
72, Bishopsgate Street Within,
LONDON, E.C.
Telephone: 365 London Wall. Telegrams: "Transumo"

RIVETS, BOLTS, & SCREWS
Of all Descriptions and for all Purposes.
SEND FOR CATALOGUE.
T. D. ROBINSON & CO., Ltd.,
DERBY.

SHONE PNEUMATIC EJECTORS
FOR RAISING SEWAGE, SLUDGE, WATER, &c.
Air Compressing Machinery
FOR ALL SERVICES.
HUGHES & LANCASTER
16, VICTORIA STREET, LONDON, S.W.

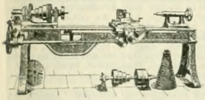
ROOFING
McTEAR & COMPANY, LTD.
ROOF CONTRACTORS, FELT MANUFACTURERS, ETC.
NEWTOWNARDS ROAD, BELFAST.
THE MAXIMUM OF AREA COVERED AT THE MINIMUM OF COST.
THE BEST ROOF FOR ALL PURPOSES
NEAT & STRONG.
FOR TANNERS, IRON FOUNDERS, ENGINEERS, ROPEWALKS, COLLERIES, SHIPBUILDERS, ELECTRICIANS.
SITES INSPECTED ESTIMATES FREE

PAGE'S WEEKLY Miscellaneous

"ZECO" Brand.
Blue Planished and Glazed Steel Sheets for Lagging and Covering generally.
ZEITZ & Co., 21, Lime St., London, E.C.

Refuse Destructors.
Write for particulars to:—
HEENAN & FROUDE, LIMITED,
4, Chapel Walks, MANCHESTER.
Works: MANCHESTER and WORCESTER.

THOMAS GREENWOOD
Waterside, HALIFAX,
has ready for immediate delivery
200
ENGINEERS' and BOILER MAKERS' MACHINE TOOLS.
Tell me your wants or send for Catalogue.



HIGH-CLASS
MACHINE TOOLS
In stock for immediate delivery.
THOS. W. WARD, L^D
Albion Works,
SHEFFIELD.

Ebonestos Mfg. Co.,
Patentees and Manufacturers of
The "EBONESTOS"
INSULATORS
Suitable for BUSHING, NIPPLES, SWITCH HANDLES, and other Insulating Fittings.
22, Rosoman Street, Clerkenwell,
LONDON, E.C.
Telephone:
422 Holborn.

Steel Structures.
THOMAS PIGGOTT & CO., LTD., SPRING HILL, BIRMINGHAM. Send for Estimates.

"TURPOLENE"
A perfect substitute for American Spirits of Turpentine for Painters, Printers, Varnish Makers, and for all other purposes where Turpentine is used.
Same odour, same flash point, same result in the working as in genuine Turps. We are the original and only makers of genuine Turpolene.
THE RELIANCE LUBRICATING OIL CO.,
19 & 20, Water Lane, Great Tower Street, London, E.C.
Branches at Glasgow, Bristol, Hull, Newcastle-on-Tyne, &c.

BERTRAMS, Ltd.,
Sciennes, EDINBURGH.
MACHINE TOOLS.
See Next Week.

EDGAR ALLEN & CO., Limited,
Sheffield.
TRAMWAY MATERIAL.
IN ALLEN'S
IMPERIAL
MANGANESE STEEL.

PAGE'S WEEKLY Contracts

CONTRACTS.

PONTYPRIDD URBAN DISTRICT COUNCIL.

ELECTRIC LIGHT AND TRAMWAYS DEPARTMENT.

The above Council invite **TENDERS** for the **SUPPLY, DELIVERY,** and **ERECTION** of ONE 300-kilowatt **STEAM DYNAMO.**

Copies of the General Conditions, Specification, and Form of Tender, prepared by Mr. J. E. Teasdel, A.M.I.E.E., Engineer and Manager, may be obtained on and after January 24th, 1906, upon receipt by the undersigned of a deposit of £2 2s., which will, after the Council shall have entered into a contract upon the Tenders received, be returned to the Tenderer, provided that he shall have sent in a *bona fide* Tender, and shall not have withdrawn the same.

Tenders, on the prescribed form, sealed, and endorsed "Tender for Steam Dynamo," must be received by the undersigned on or before **FEBRUARY** 13th, 1906.

The Council do not bind themselves to accept the lowest or any Tender.

J. COLFNSO JONES,
Clerk to the Council.

District Council Offices, Pontypridd, January 15th, 1906.

THE SOUTH INDIAN RAILWAY COMPANY, LIMITED,

is prepared to receive **TENDERS** for the SUPPLY of

21 LOCOMOTIVES with TENDERS (mixed Passenger and Goods).

Specifications and Forms of Tender may be obtained at the Company's offices.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Locomotives," must be left with the undersigned not later than 12 o'clock noon of Tuesday, February 6th, 1906.

The Company is not bound to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £2 for each copy of the specification.

The drawings may be inspected at the office of Sir George B. Bruce, 3, Victoria Street, Westminster.

By order, HENRY W. NOTMAN,
Managing Director.

Company's Offices:
55, Gracechurch Street, London,
January 19th, 1906.

WILTON DRAINAGE.—CONTRACT No. 1.

TO CONTRACTORS.

The Mayor and Corporation of Wilton are prepared to receive **TENDERS** for the **CONSTRUCTION** of the following **WORKS**:—

About 1¾ miles of Patent Stoneware and Iron Sewers, ranging in size from 8-in. to 30-in., with the necessary Manholes and Flushing Tanks, together with Pumping Station, Rising Main, and other works, in accordance with the Specification and Plans prepared by Messrs. John Taylor, Sons and Santo Crimp, Civil Engineers.

Copies of the Specification and Quantities, with form of Tender, may be obtained from, and the Drawings inspected at, the offices of the said Messrs. John Taylor, Sons and Santo Crimp, 27, Great George Street, Westminster, S.W., upon payment of £5 (cheque only), which will be returned upon the receipt of a *bona fide* Tender.

Tenders, endorsed "Wilton Drainage, Contract No. 1," are to be delivered to me on or before Saturday, the third day of February, 1906.

The Corporation do not bind themselves to accept the lowest or any Tender.

By order, HENRY J. KING,
Town Clerk.

Wilton, Salisbury, January 6th, 1936.

COUNTY BOROUGH OF WOLVERHAMPTON.

TO WIRE ROPEWAY CONTRACTORS.

The Corporation of Wolverhampton are prepared to receive **TENDERS** for the **MANUFACTURE, DELIVERY,** and **ERECTION** of an **AERIAL ROPEWAY**, approximately 1300 yards in length, and other works incidental thereto, from Contractors who pay to the whole of their workmen such rate of wages and observe such hours of labour as are recognised by the Workmen's Trade Unions and the Associations of Employers in the several localities where their work is done.

A Copy of the Specification and Form of Tender may be obtained from Mr. E. A. B. Woodward, Waterworks Engineer, Town Hall, Wolverhampton, upon payment by P.O.O. of the sum of £2 2s., which amount will be refunded to each Contractor who submits a *bona fide* Tender.

Each Tender must be enclosed in a sealed cover addressed to "The Chairman of the Water Committee," and endorsed "Ropeway," and delivered at my office before 10 a.m. on Monday, the 5th day of February next.

The right to decline the lowest or any Tender is reserved to the Corporation.

HORATIO BREVITT,
Town Clerk.

Town Hall, Wolverhampton,
16th January, 1906.

METROPOLITAN BOROUGH OF FULHAM.

ELECTRICITY DEPARTMENT.

CONTRACT "S."

The Council is prepared to receive **TENDERS** for the **SUPPLY** and **ERECTION** of

(*a*) Steam Piping.
(*b*) Water and Exhaust Piping.

Specifications and forms of Tender may be obtained from the Borough Electrical and Consulting Engineer, Mr. Arthur J. Fuller, after the 13th instant, on payment of a deposit of One Guinea, which will be returned on receipt of a *bona fide* tender.

Tenders, made out on the form supplied, addressed to the Town Clerk, Town Hall, Fulham, and endorsed "Tender for Contract S," to be delivered at the Town Hall not later than 12 noon on Wednesday, January 31st, 1906.

Contractors will be required to abide by the Council's standing orders as to hours of labour and rates of pay.

The lowest or any Tender not necessarily accepted.

By order,
R. M. PRESCOTT,
Town Clerk.

Town Hall, Fulham, S.W., January 9th, 1906.

SUPPLY AND ERECTION OF A REFUSE DESTRUCTOR.

TENDERS are invited by the Municipality of Pretoria, Transvaal, for the **SUPPLY** and **ERECTION** of a **REFUSE DESTRUCTOR**, capable of treating 60 tons of refuse per diem.

Tender Forms, Specification of the Destructor, Dimensions, and Levels of the Site upon which it will be erected, may be obtained on application to the Town Engineer, Pretoria, or at the office of Messrs. Mosenthal, Sons, and Co., 72, Basinghall Street, London, E.C.

The successful tenderer will be required to pay to workmen employed on the erection of the above works wages at rates not less, and to observe hours of labour not greater, than the rates and hours set out in a list to be seen at the office of Messrs. Mosenthal, Sons, and Co.; such rates of wages and hours of labour will form part of the contract to be entered into by the successful tenderer.

Tenders, enclosed in sealed envelopes, and endorsed "Tenders for Supply and Erection of Refuse Destructor at Pretoria," must reach the undersigned not later than March 15th, 1906, or the Town Clerk, Pretoria, not later than noon on April 6th, 1906.

The lowest or any Tender will not necessarily be accepted.

MOSENTHAL, SONS, AND CO.,
Representing Municipality of Pretoria.

COUNTY OF LONDON.—TO ENGINEERS AND OTHERS.

The London County Council invites **TENDERS** for the **MANUFACTURE, SUPPLY,** and **ERECTION** of **THREE GAS ENGINES**, each having three inverted single-acting cylinders over three cranks, and each capable of developing 350 brake horse-power at a speed of 100 revolutions per minute.

Persons desiring to submit Tenders may obtain the Drawing, Specification, Form of Tender, and other particulars upon application to the Chief Engineer, Mr. Maurice Fitzmaurice, C.M.G., at the County Hall, Spring Gardens, S.W., upon payment to the Cashier of the Council of the sum of £2.

This amount will, after the Council or its Committee have come to a decision upon the Tenders received, but not before, be returned to the tenderer, provided he shall have sent in a *bona fide* Tender, and not have withdrawn the same.

Tenders must be upon the official Forms, and the printed instructions contained therein must be strictly complied with.

The Contractors will be bound by the Contract to pay to all workmen (except a reasonable number of legally bound apprentiees) employed by them wages at rates not less, and to observe hours of labour not greater, than the rates and hours set out in the Council's list, and such rates of wages and hours of labour will be inserted in, and form part of the Contract by way of schedule.

Each Tender is to be delivered at the County Hall in a sealed cover addressed to "The Clerk of the London County Council, Spring Gardens, S.W.," and marked "Tender for Gas Engines, Shad Thames Pumping Station."

No Tender will be received after 10 a.m. on Tuesday, February 20th 1906.

Any Tender which does not comply with the printed instructions for Tender may be rejected.

The Council does not bind itself to accept the lowest or any Tender and it will not accept the Tender of any person or firm who shall on any previous occasion have withdrawn a Tender after the same had been opened, unless the reasons for the withdrawal were satisfactory to the Council.

G. L. GOMME,
Clerk of the London County Council.

County Hall, Spring Gardens, S.W.
January 16th, 1906.

PAGE'S WEEKLY Contracts and Appointments Open

BATTERSEA BOROUGH COUNCIL.

The Electricity Committee invite **TENDERS** for the following **PLANT and MATERIALS**:

1. One Set either 750-850 or 1,000 kw. D.C. 460 to 550 volts Steam Generator, Piping, and Ejector Condenser.
2. Arc Lamp Columns.
3. Arc Lamps.
4. Arc Lamp Globes.

Copies of Specification and Form of Tender can be obtained on or after January 11th by making application and enclosing the sum of £2 2s. to the Chief Engineer, Electricity Department, Lombard Road, Battersea, which sum will be refunded on receipt of *bona fide* Tender.

Tenders are to be returned, endorsed "Tender for ——," to the undersigned not later than noon, Monday, February 5th.

W MARCUS WILKINS,
Town Clerk.

Municipal Buildings, Lavender Hill, S.W.

EPSOM URBAN DISTRICT COUNCIL.

WATERWORKS PUMPING PLANT.

TENDERS are invited for **SUPPLYING** and **ERECTING** a **GAS ENGINE** and **SUCTION GAS PLANT** and a **DEEP WELL PUMP** capable of raising 50,000 gallons of water per hour against a head of 390 feet.

The work to be carried out to the specification, and to the satisfaction of Mr. W. VAUX GRAHAM, M.Inst.C.E., 5, Queen Anne's-gate, Westminster, from whom full particulars may be obtained on payment of £5 5s., which will be returned on receipt of a *bona fide* Tender.

Tenders must be sent in to Mr. E. G. WILSON, Clerk to the Epsom Urban District Council, Church Street, Epsom, marked "Tender for Pumping Plant," not later than first post on Monday, February 12th, 1906.

The Council do not bind themselves to accept the lowest or any Tender.

EAST INDIAN RAILWAY. — The East Indian Railway Company is prepared to receive **TENDERS** for the **SUPPLY** and **DELIVERY** of:

BRASS BOILER TUBES.

as per Specification to be seen at the Company's Offices.

Tenders are to be sent to the undersigned, marked "Tender for Brass Boiler Tubes," not later than Twelve o'clock noon, on Wednesday, the 31st day of January instant.

The Company reserves to itself the right to divide the order, also to decline any Tender without assigning a reason, and does not bind itself to accept the lowest or any Tender.

For each Specification a fee of £1 1s. is charged, which cannot under any circumstances be returned.

By order,
C. W. YOUNG,
Secretary.

Nicholas Lane, London, E.C.
January 18th, 1906.

METROPOLITAN WATER BOARD.

TENDERS FOR THE SUPPLIES OF STORES AND THE EXECUTION OF WORKS.

The Metropolitan Water Board are prepared to receive **TENDERS** for the undermentioned for the Twelve Months ending March 31st 1907:—

Tender No. 1. Brushes and Brooms,
2. Cast Iron Pipes and Specials.
3. Cotton Waste.
6. Oils, Lighting and Lubricating.
7. Hemp Rope, &c.
8. Ironmongery and Tools.
9. Iron and Steel.
10. India-rubber and Packings.
11. Lead Pipe and Solder.
12. Oilman's Sundries.
13. Paints, Colours, Varnishes, &c.
14. Pipe Laying, Repairs, &c.
15. Plumbing Work.
16. Screw-down Stop Ferrules, &c.
17. Small Iron, Brass, and other Castings.
19. Sluice Valves.
20. Wood Plugs and Elm Logs.

Tenders must be made on official forms, which may be obtained from the undersigned, by personal application, or on receipt of stamped addressed envelopes.

Applications should refer to the number of the tender for which forms are required.

The latest time for receiving Tenders (which must be sent under sealed cover to the Clerk of the Board, endorsed "Tender for ——,") is 10 a.m. on Monday, February 5th, 1906.

By order,
A. B. PILLING,
Clerk of the Board.

Offices of the Board,
Savoy-court, Strand, W.C.
January 15th, 1906.

BOROUGH OF STOKE-UPON-TRENT.

ELECTRICITY COMMITTEE.

CONTRACT 12.

The above Committee invite **TENDERS** for the **SUPPLY** and **DELIVERY** of **METERS** and **DEMAND INDICATORS** during the year ending March 31st, 1907.

Specifications and Forms of Tender may be obtained from the undersigned on payment of a deposit of £2 2s., which will be returned on receipt of a *bona fide* Tender.

Tenders to be sent in, addressed "The Electricity Committee," Electricity Works, Stoke-upon-Trent, not later than January 31st, 1906, and endorsed "Tender for Meters."

The Committee do not bind themselves to accept the lowest or any Tender.

(Signed) P. J. S. TIDDEMAN,
Borough Electrical Engineer.

Electricity Works, Stoke-upon-Trent, January 9th, 1906.

APPOINTMENTS OPEN.

INDIAN PUBLIC WORKS DEPARTMENT.

The Secretary of State for India in Council will, in the Summer of 1906, make not less than **TEN APPOINTMENTS** of **ASSISTANT ENGINEER** in the Permanent Establishment of the Indian Public Works Department, in addition to the appointments to be made from Cooper's Hill College.

The age of Candidates must not be less than 21, or more than 24 years on the 1st July, 1906.

A printed Form of Application, together with information regarding the conditions of the appointments and certain requirements laid down as to education and experience in engineering, may be obtained from the Secretary, Public Department, India Office, Whitehall, London, S.W.

The Form of Application is to be returned so as to reach him not later than Tuesday, 1st May next.

A. GODLEY,
Under Secretary of State.

India Office, December 19th, 1905.

AN "INSTITUTION OF NAVAL ARCHITECTS" SCHOLARSHIP, of the annual value of £50, and, subject to certain conditions, tenable for three years, will be **OFFERED** for **COMPETITION** by the Council of the above Institution.

Candidates must, at the time of the examination, be students of the Institution, and not less than eighteen or more than twenty-one years of age on March 1st, 1906, and must at that date have been continuously employed for two years upon Naval Architecture or Marine Engineering.

Further particulars and forms of entry and conditions regulating the admission of students, may be obtained from the Secretary, Institution of Naval Architects, 5, Adelphi Terrace, London, W.C.

Applications must be sent in by February 1st, 1906.

SWADLINCOTE DISTRICT URBAN DISTRICT COUNCIL.

APPOINTMENT OF SURVEYOR AND WATER ENGINEER

The Council invite **APPLICATIONS** for the above **APPOINTMENT**

The gentleman appointed will be required to devote his whole time to the duties of his office.

The salary as Surveyor will be £250 per annum, and as Water Engineer to the Joint Water Committee of Swadlincote and Ashby-de-la-Zouch £40 per annum.

The Council district contains an area of 3,415 acres, a population of 19,500, and a rateable value of £65,000.

The Waterworks are situate at Milton and Woodville.

Applications, in candidates' own handwriting, stating age and qualifications, with three recent testimonials, must be sent to me, the undersigned, at the Council Office, not later than Wednesday, January 31st, endorsed "Surveyor."

Three months' notice at any time to determine the engagement.

Canvassing, either directly or indirectly, will be deemed a disqualification.

By order of the Council,
W. A. MUSSON,
Clerk.

Council Office,
Belmont Street, Swadlincote,
January 3rd, 1906.

UNIVERSITY COLLEGE, NOTTINGHAM

TWO JUNIOR DEMONSTRATORS and LECTURERS are Required to begin work on May 1st, 1906, one for Physics, the other for Engineering.

Applications by February 10th, on Forms which can be obtained from the Registrar.

Salary £130, rising by £10 a year to £180.

BUYERS' DIRECTORY.

NOTE.—The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index to Advertisers on pages 22 and 24.

In order to assure fair treatment to advertisers, each firm is indexed under its leading speciality ONLY.

Advertisers who prefer, however, to be entered under two or more different sections can do so by an annual payment of 5s. for each additional section.

Advertisers' Service Bureau.
British Advertiser Service Bureau, Queen Anne's Chambers, Westminster, S.W.

Artesian Well Machinery.
John Z. Thom, Patricroft, Manchester.

Band Sawing Machines.
Noble & Lund, Ltd., Felling-on-Tyne.

Bearings (Roller).
Hyatt Roller Bearing Co., 47, Victoria Street, London S.W.

Belting.
Binney & Son, Catherine Street, City Road, London, E.C.
Cort, Arthur, & Co., Camberwell, London, S.E.
Fleming, Birkby & Goodall, Ltd., West Grove, Halifax.
Gilmour, W. & O., St. John's Hill, Edinburgh.

Boilers.
Clayton, Son & Co., Ltd., Leeds City Boiler Works, Leeds.
Hartley & Sugden, Ltd., Halifax.
Thompson, John, Wolverhampton.

Boilers (Water-tube).
Babcock & Wilcox, Ltd., Oriel House, Farringdon Street London. E.C.
Stirling Boiler Co., Ltd., Motherwell, N.B.

Bolts, Nuts, Rivets, etc.
Herbert W. Periam, Ltd., Floodgate Street Works, Birmingham.
T. D. Robinson & Co., Ltd., Derby.

Books.
Griffin, Charles, & Co., Exeter Street, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.
Spon, E. & F. N., 125, Strand, W.C.

Boring Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.

Cables.
Callender's Cable and Construction Co., Ltd.

Case-Hardening Compounds.
Hy. Miller & Co., Millgarth Works, Leeds.

Castings.
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.

Catalogues, Printing, &c.
Atlantic Press, Ltd., Weymouth Street, Manchester.
Spottiswoode Advertising Agency, Clun House, Surrey Street, Strand, W.C.
Stafford, Arthur, & Co., Denton, Manchester.

Chucks.
Fairbanks Co., 78-80, City Road, London, E.C.

Cisterns, Tanks, &c.
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.
Clayton, Son & Co., Ltd., Hunslet, Leeds.
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Clutches (Friction).
David Bridge & Co., Castleton Ironworks, Rochdale, Lancashire.

Coke Oven Expert.
Mallmann, P. J., 110-118, Victoria Street, S.W.

Condensing Plant.
Benn, Sykes, Haslingden, near Manchester.
Concentric Condenser, Ltd., 23, Northumberland Avenue, London, W.C.
Mirrlees-Watson & Co., Ltd., Glasgow

Consulting Engineers.
Gibbs, John, & Son, 80, Juke Street, Liverpool.
G. H. Hughes, A.M.I.M.E., 19, Old Queen Street, Westminster, S.W.
Melville & Macalpine, 615, Walnut Street, Philadelphia, Pa., U.S.A.
Mount-Haes, A., M.I.Mech.E., M.I.M.E., 11, Ironmonger Lane, London, E.C.

Continental Railway Arrangements.
Northern Railway of France.
South Eastern & Chatham Railway Co.

Conveying and Elevating Machinery.
Adolf Bleichert & Co., Leipzig-Gohlis, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Temperley Transporter Co., 72, Bishopsgate Street Within, London, E.C.

Copper and Brass.
W. Hepton & Son, Hunslet Lane, Leeds.

Coverings (Boiler).
Magnesia Covering Ltd., Washington Station, co. Durham.

Cranes, Travellers, Winches, etc.
Joseph Booth & Bros. Ltd, Rodley, Leeds.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Cranks.
Clarke's Crank & Forge Co., Ltd., Lincoln, England.

Cutters (Milling).
Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.
E. G. Wrigley & Co., Ltd., Foundry Lane Works, Soho, Birmingham.

Destructors.
Heenan & Froude, 4, Chapel Walks, Manchester.
Horsfall Destructor Co., Ltd., Armley, Leeds.

Dredges and Excavators.
Delange & Cie, Mce., Hoboken, near Antwerp
Rose, Downs & Thompson, Ltd., Old Foundry, Hull

Drilling Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Niles-Bement-Pond Co., 23-25, Victoria Street London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne
Swift, George, Clarence Ironworks, Halifax.

Economisers.
E. Green & Son, Ltd., Manchester.

Ejectors (Pneumatic).
Hughes & Lancaster, 16, Victoria Street, London, S.W.

Electrical Apparatus.
Allgemeine Elektricitäts Gesellschaft, Berlin, Germany.
British Westinghouse Electric and Manufacturing Co., Ltd., Norfolk Street, Strand, London, W.C.
Broadbent, T. W., Victoria Electrical Works, Huddersfield.
Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey Street, London, S.E.
Ebonestos Manufacturing Co., 22, Rosoman Street, London, E.C.
Gent & Co., Ltd., Faraday Works, Leicester.
Greenwood & Batley, Ltd., Albion Works, Leeds.
India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., Silvertown, London, E.
Johnson and Phillips, Ltd., Victoria Works, Old Charlton, Kent.
Matthews & Yates, Ltd., Swinton, Manchester.
Mix and Genest, Berlin, W., Germany.
Nalder Bros. & Thompson, 34, Queen Street, London, E.C.
New Gutta Percha Co., Ltd., Dashwood House, New Broad Street, E.C.
Newton Brothers, Full Street, Derby.
Phœnix Dynamo Manufacturing Co., Bradford, Yorks.
Scott, E., & Mountain, Ltd., Newcastle-on-Tyne.
Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street London, E.C.
Turner, Atherton & Co., Ltd., Denton, Manchester.
B. Weaver & Co. (*see* Ebonestos Manufacturing Co.), 22, Rosoman Street, Clerkenwell, London, E.C.

Engineers' Supplies.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Engines (Gas).
Campbell Gas Engine Co., Ltd., Halifax.
Cundall, Son & Co., Ltd., Airedale Iron Works, Shipley.

Engines (Electric Lighting).
McLaren, J. and H., Midland Engine Works, Leeds.

Engines (Locomotive).
Baldwin Locomotive Works, Philadelphia, Pa., U.S.A.
Hunslet Engine Co., Ltd., Leeds, England.
Hudswell, Clarke & Co., Ltd., Leeds, England.
McLaren, J. & H., Midland Engine Works, Leeds.

Engines (Stationary).
Allis-Chalmers Co., 533, Salisbury House Finsbury Circus, London E.C.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Mirrlees Watson Co., Ltd., Glasgow.

Engines (Traction).
Jno. Fowler & Co. (Leeds), Ltd., Steam Plough Works, Leeds.

Engravers.
Jno. Swain & Son, Ltd., 58, Farringdon Street, London, E.C.

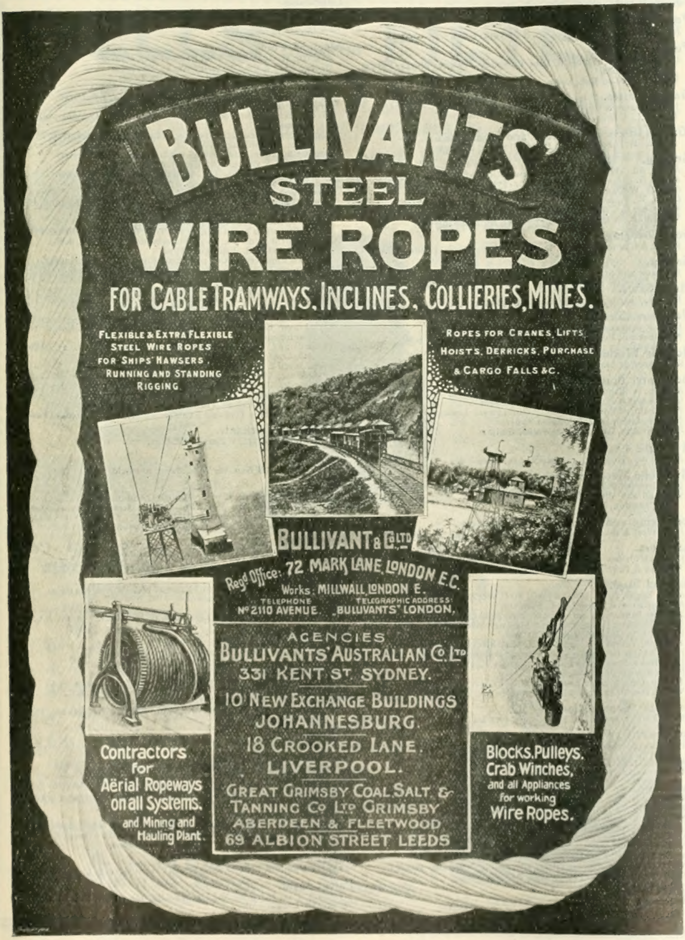
Exhaust Steam Oil Separators.
Lancaster & Tonge, Ltd., Pendleton, Manchester.

Fans, Blowers.
Capel Fan Co., 13, Moseley Street, Newcastle-on-Tyne.
Davidson & Co., Ltd., "Sirocco" Engineering Works, Belfast, Ireland.
Gibbs, John & Son, 80, Juke Street, Liverpool.
Matthews & Yates, Ltd., Swinton, Manchester.

Files.
Flockton, Tompkin & Co., Ltd., Newhall Steel Works, Sheffield.

Fire Bricks.
J. H. Sankey & Son, Ltd., Essex Wharf, Canning Town, London, E.

Firewood Machinery.
M. Glover & Co., Patentees and Saw Mill Engineers, Leeds.
Hill and Herbert, Ltd., Great Central Street, Leicester.



BULLIVANTS'
STEEL
WIRE ROPES
FOR CABLE TRAMWAYS. INCLINES. COLLIERIES. MINES.

FLEXIBLE & EXTRA FLEXIBLE STEEL WIRE ROPES FOR SHIPS' HAWSERS, RUNNING AND STANDING RIGGING.

ROPES FOR CRANES, LIFTS, HOISTS, DERRICKS, PURCHASE & CARGO FALLS &C.

BULLIVANT & Co. LTD.
Regd Office: 72 MARK LANE, LONDON, E.C.
Works: MILLWALL, LONDON E.
TELEPHONE Nº 2110 AVENUE. TELEGRAPHIC ADDRESS: "BULLIVANTS" LONDON.

AGENCIES
BULLIVANTS' AUSTRALIAN Co. LTD
331 KENT ST. SYDNEY.

10 NEW EXCHANGE BUILDINGS
JOHANNESBURG.

18 CROOKED LANE
LIVERPOOL.

GREAT GRIMSBY COAL SALT & TANNING Co LTD GRIMSBY
ABERDEEN & FLEETWOOD
69 ALBION STREET LEEDS

Contractors for Aërial Ropeways on all Systems. and Mining and Hauling Plant.

Blocks. Pulleys. Crab Winches, and all Appliances for working Wire Ropes.

Buyers' Directory—(*Continued*).

Fountain Pens.
Mabie, Todd & Bard, 93, Cheapside, London E.C.

Forging (Drop) Plants.
Brett's Patent Lifter Co., Ltd., Coventry.

Forgings (Drop).
J. H. Williams & Co., Brooklyn, New York, U.S.A

Furnaces.
Deighton's Patent Flue & Tube Company, Vulcan Works, Pepper Road, Leeds.
Leeds Forge Co., Ltd., Leeds.

Gauge Glasses.
J. B. Treasure & Co., Vauxhall Road, Liverpool.
Tomey, J., & Sons, Aston, Birmingham.

Gauges (Pressure, Vacuum, and Hydraulic).
Dobbie, McInnes, Ltd., 45, Bothwell Street, Glasgow.

Gearing.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.
Angus, G. & Co., Ltd., Newcastle-on-Tyne.
Asquith, William, Ltd., Well Road Works, Halifax.
Dixon, W. F., & Co., 60, Percival Street, C.-on-M. Manchester
Reid Gear Co., Linwood, near Glasgow.
Wild, M. B., & Co., Corporation Street, Birmingham.

Gold Dredging Plant.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C

Greases.
Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.

Hack Saws.
Baynes, Charles, Knuzden Brook, Blackburn.

Hammers (Steam).
Davis & Primrose, Leith Ironworks, Edinburgh.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Hoisting Machinery.
See Conveying Machinery.

Horizontal Boring Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Greenwood & Batley, Albion Works, Leeds.
Niles-Bement Pond Co., 23-25, Victoria Street London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Swift, George, Clarence Ironworks, Halifax.

Hydraulic Leather.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Hydraulic Machine Tools.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Vauxhall and West Hydraulic Engineering Co. Ltd., 23, College Hill, London, E.C.

Icemaking and Refrigerating Machinery.
H. J. West & Co., 114-118, Southwark Bridge Road, London, S.E.

Indicators.
Dobbie McInnes, Ltd., 45, Bothwell Street, Glasgow.
Hannan & Buchanan, 75, Robertson Street, Glasgow.

Iron and Steel.
Allen, Edgar, & Co. Ltd., Imperial Steel Works, Sheffield.
Askham Bros. & Wilson, Ltd., Sheffield.
Buckley, Saml., St. Paul's Square, Birmingham.
Fairley & Sons, James, Old Mint, Shadwell Street, Birmingham.
Farnley Iron Co., Ltd., Leeds England
Flockton, Tompkin & Co., Ltd., Newhall Steel Works, Sheffield.
Fried. Krupp, Grusonwerk, Magdeburg-Buckau, Germany.
J. Frederick Melling, 14, Park Row, Leeds, England.
Parker Foundry Co., Derby.
Purden, John & Sons, Lambhill Forge, by Maryhill, Glasgow.
Walter Scott, Ltd., Leeds Steel Works, Leeds, England.

Ironwork (Constructional).
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Ironwork (Galvanised).
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Lagging Sheets.
Zeitz & Co., 21, Lime Street, London, E.C.

Lathes.
Asquith, William, Ltd., Well Road Works, Halifax.
Bradbury & Co., Ltd., Wellington Works, Oldham.
Eclipse Tool Manufacturing Co., Linwood, near Glasgow.
Leckenby, Benton, & Co., Perseverance Ironworks, Halifax.
Mitchell, D., & Co., Ltd., Parsonage Works Keighley.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Northern Engineering Co. (1900), Ltd., King Cross, near Halifax.
Swift, George, Clarence Ironworks, Halifax.

Lathe Carriers
Williams, J. H., & Co., Brooklyn New York, U.S.A.

Laundry Machinery.
Hill and Herbert, Ltd., Great Central Street, Leicester.
Summerscales, W., & Sons, Ltd., Engineers, Phœnix Foundry, Keighley, England.

Lifts.
Waygood & Co., Ltd., Falmouth Road, London, S.E.

Lubricants.
Blumann & Stern, Ltd., Plough Bridge, Deptford, London S.E.
Reliance Lubricating Oil Co., The, 19 & 20, Water Lane, Great Tower Street, London, E.C.

Machine Tools.
Asquith, William, Ltd., Well Road Works, Halifax.
George Addy & Co., Waverley Works, Sheffield.
Bateman's Machine Tool Co., Hunslet, Leeds.
Beanland, Perkin, & Co., School Close Works, Leeds.
Bertrams, Ltd., St. Katherine's Works, Sciennes, Edinburgh.
Bradbury & Co., Ltd., Wellington Works, Oldham.
Breuer, Schumacher & Co., Ltd., Kalk, near Cologne-on-Rhine (Germany).
Consolidated Pneumatic Tool Co., Ltd., Palace Chambers, 9, Bridge Street, Westminster, S.W.
Cunliffe & Croom, Ltd., Broughton Ironworks, Manchester.
Dean, Smith & Grace, Ltd., Keighley.
Dempster, Moore & Co., Ltd., 49, Robertson Street, Glasgow.
Fengl, A., & Co., Gratton Street, Altrincham.
Greenwood & Batley, Ltd., Leeds.
Jones & Lamson Machine Co., 97, Queen Victoria Street, London, E.C.
John Lang & Sons, Johnstone, near Glasgow.
Luke & Spencer, Ltd., Broadheath, Manchester.
Jos. C. Nicholson Tool Co., City Rd. Tool Wks., Newcastle-on-Tyne.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund Ltd., Felling-on-Tyne.
Northern Engineering Co., 1900, Ltd., King Cross, near Halifax.
J. Parkinson & Son, Canal Ironworks, Shipley, Yorkshire.
C. Redman & Sons, Halifax.
Resides, 12, Aire Street, Brighouse, Yorks.
Rice & Co. (Leeds), Ltd., Leeds, England.
G. F. Smith, Ltd., South Parade, Halifax.
Swift, George, Clarence Ironworks, Halifax.
Taylor and Challen, Ltd., Derwent Foundry, Constitution Hill Birmingham.
Vauxhall and West Hydraulic Engineering Co., Ltd., 23, College Hill, London, E.C.
H. W. Ward & Co., Lionel Street, Birmingham.
T. W. Ward, Albion Works, Sheffield.
West Hydraulic Engineering Co. (see Vauxhall and West Hydraulic Engineering Co. Ltd.), 23, College Hill, London, E.C.
Winn, Charles, & Co., St. Thomas Works, Birmingham.
Yorkshire Machine Tool and Engineering Works, Liversedge, Yorks.

Machinery Merchants.
Greenwood, Thomas, Waterside, Halifax.

Marks.
Pryor, Edward, & Son, 68, West Street, Sheffield.

Metals.
Delta Metal Co., Ltd., East Greenwich, London, S.E.
Magnolia Anti-Friction Metal Co., Ltd., of Great Britain, 49, Queen Victoria Street, London, E.C.
Phosphor Bronze Co., Ltd., Southwark, London, S.E.

Metals (Perforated).
Brown, Andrew, & Co., 110, Cannon Street, London, E.C.
Méguin, Fr., & Co., Ltd., Engineering Works, Dillingen-on-Saar.

Mining Drill Steel.
Flockton, Tompkin & Co., Ltd., Newhall Steel Works, Sheffield.

Mining Machinery.
Fraser & Chalmers, Ltd., 3 London Wall Buildings, London, E.C.

Office Appliances.
Davis John, & Son, Ltd., 30, All Saints' Works, Derby.
Halden & Co., J., 8, Albert Square, Manchester.
Hall & Co., B. J., 39, Victoria Street, London, S.W.
Inglesant, T., & Sons, Ltd., Atlas House, Leicester.
Lyle Co., Ltd., Harrison Street, Gray's Inn Road, London, W.C.
Rookwell-Wabash Co. Ltd., 69, Milton Street, London, E.C.
Shannon, Ltd., Ropemaker Street, London, E.C.
Trading and Manufacturing Co., Ltd., Temple Bar House, Fleet Street, London, E.C.

Oils, &c.
Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.

Oil Filters and Cabinets.
Valor Co., Ltd., Rocky Lane, Aston Cross, Birmingham.

Packing.
Beldam Packing & Rubber Co., 93-94, Gracechurch Street, London E.C.
Lancaster & Tonge, Ltd., Pendleton, Manchester.
Redfern & Co., S., Swan Lane, New Brown Street, Manchester.
Quaker City Rubber Co., Coronation House, Lloyd's Avenue, E.C.
United States Metallic Packing Co., Ltd., Bradford,

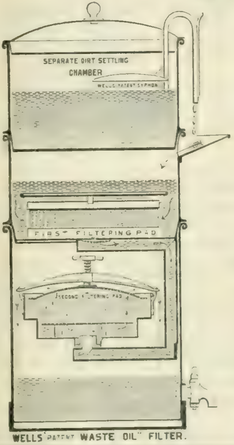
Paper.
Lepard & Smiths, Ltd., 29, King Street, Covent Garden, London, W.C.

Patent Agent.
Lorrain, J. G., M.I.E.E., M.I.Mech.E., Norfolk House, Norfolk Street Strand, London, W.C.

PAGE'S WEEKLY Wells' Specialities

WELLS' PATENT "Waste Oil" FILTERS

FITTED WITH SIGHT-FEED SYPHON.



WELLS' PATENT "WASTE OIL" FILTER.

SUPPLIED TO THE PRINCIPAL GOVERNMENTS FOR THE NAVY, DOCKYARDS, &c., AND TO THE LEADING ELECTRIC LIGHT INSTALLATIONS, ENGINEERING WORKS, GAS ENGINE MAKERS, PRINTERS, &c., &c.

OVER 11,000 SOLD.

MONEY SAVERS to any USERS OF MACHINERY.

Pay first cost in a short time, as Dirtied Oil, which has hitherto been thrown away, can be filtered and used again and again.

Write for List of Testimonials and Samples of Work done by the Filter.

No. 1.—For users having only a small quantity of oil to treat on syphon, 17 in. by 9 in. .. .	35/-
No. 2.—Two top chambers hold about 3 gallons oil, 22 in. by 10 in. ..	50/-
No. 3.—Two top chambers hold about 6 gallons oil, 27 in. by 12 in. ...	70/-
No. 4.—Two top chambers hold about 12 gallons oil, 36 in. by 16 in. ...	110/-
No. 5.—Two top chambers hold about 24 gallons oil, 43 in. by 23 in. ...	189/-
No. 6.—Very powerful Filter for treating large quantities of oil, 54 in. by 36 in.	336/-

Capable of dealing with 250 Galls. Oil per week

LARGER SIZES MADE TO ORDER.

NO OUTSIDE POWER REQUIRED.

LIME, WHITING, OR COLD WATER PAINTS,

Applied at a speed of from 8 to 10 square yards per minute, in a manner superior to brush work.

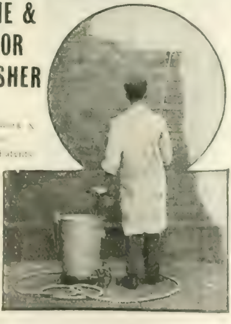
One coat with the Machine on rough surfaces is equal to two applied with brushes.

Will save First Cost in a Few Days.

No. 6A.	Small [illegible] Rail	£5 15s.
No. 4.	Price, with [illegible] ft. Pole Single Spraying Nozzle, and [illegible] ft. Special Armoured Hose. Capacity [illegible] gals.	£8 10s.
No. 4A	Price, with Wheels, [illegible] ft. Pole Single Spraying Nozzle and [illegible] ft. Special Armoured Hose Same capacity as No. 4 Machine.	£9 10s.
No. 5.	With [illegible] ft. Pole Double Spraying Nozzle, and 20 ft. Special Armoured Hose Large size. Capacity [illegible] gals.	£10 10s.
No. 5A.	Ditto Ditto fitted with Wheels	£11 15s.

WELLS' "LIGHTNING" LIME & COLOR WASHER

W[illegible]
W[illegible]
Patents



No. 4a, with Wheels.

WELLS' IMPROVED LIMEWASH.

MUCH SUPERIOR TO ORDINARY LIMEWASH. SLAKED WITH WATER QUICKLY MIXED. WILL NOT RUB OFF. LEAVES A GOOD SURFACE.

Price 13/8 per cwt.,
Carriage Paid in England and Wales. (If in lots of 3 cwt. at a time, 12/8 per cwt.)

A. C. WELLS & Co.,
100a, Midland Road, St. Pancras,
LONDON, N.W.
Works: Cheetham, Manchester.

Buyers' Directory—(*Continued*).

Photo Copying Frames.

J. Halden & Co., 8, Albert Square, Manchester.
B. J. Hall & Co., 39, Victoria Street, London, S.W.

Photographic Apparatus.

Marion & Co., Ltd., 22 and 23, Soho Square London, W.

Pinch Bars.

Samson & Co., Garforth, near Leeds.

Pipe Wrenches (Chain).

Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Pistons.

Lancaster & Tonge, Ltd., Pendleton, Manchester.

Planished Sheets.

Zeitz & Co., 21, Lime Street, London, E.C.

Pneumatic Tools.

Consolidated Pneumatic Tool Co., Ltd., Palace Chambers, 9, Bridge Street, Westminster, S.W.

Porcelain.

Gustav Richter, Charlottenburg, near Berlin, Germany.

Presses (Hydraulic).

Greenwood & Batley, Albion Works, Leeds
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Publishers.

Charles Griffin & Co., Ltd., Exeter Street, Strand, London, W.C.
Spon, E. and F. N., 125, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.

Pulley Blocks.

[illegible] Ltd., Locksbrook Engineering Works, Bath.

Pumps and Pumping Machinery.

Drum Engineering Co., 33, Brook Street, Bradford.
Enke, Carl, Schkeuditz-Leipzig, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
J. P. Hall & Sons, Ltd., Peterborough
Hathorn, Davey & Co., Ltd., Leeds, England.
Positive Rotary Pumps, Ltd., 23, Northumberland Avenue, London, W.C.

Radial Drilling Machines.

Asquith, William, Ltd., Well Road Works, Halifax.
Greenwood & Batley, Albion Works, Leeds.
Mitchell, D., & Co. Ltd., Parsonage Works, Keighley.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Northern Engineering Co. (1900), Ltd., King Cross, near Halifax.
Swift, George, Clarence Ironworks, Halifax.

Rails.

Wm. Firth, Ltd., Leeds.

Riveted Work.

F. A. Keep, Juxon & Co., Forward Works, Barn Street, Birmingham

Roller Bearings.

Hyatt Roller Bearing Co., 47, Victoria Street, London, S.W

Roofs.

D. Anderson & Son, Ltd., Lagan Felt Works, Belfast.
Clayton, Son & Co., Ltd., Hunslet, Leeds.
Head, Wrightson & Co., Ltd., Thornaby-on-Tees.
McTear & Co., Ltd., Newtownards Road, Belfast.

Ropeways (Aerial).

Bullivant & Co., Ltd., 72, Mark Lane, London, E.C.
Pohlig, J., Ltd., Cologne, Germany.

Scientific Instruments.

Cambridge Scientific Instrument Co., Ltd. Cambridge

Slotting Machines.

Swift, George, Clarence Ironworks, Halifax.

Spanners.

Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Stampings.

Thomas Smith & Sons of Saltley, Ltd., Birmingham.
Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Stamps (Rubber).

Rubber Stamp Co., 1 & 2, Holborn Buildings Broad Street Corner, Birmingham.

Stamps (Metal).

Edward Pryor & Son, 68, West Street, Sheffield.

Steam Traps.

Lancaster & Tonge, Ltd., Pendleton, Manchester.

Steam Wagons.

Thornycroft & Co., Ltd., J. I., Chiswick, London, W.
Yorkshire Patent Steam Wagon Co., Pepper Road, Hunslet, Leeds.

Steel Structures.

Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees
Clayton, Son & Co., Ltd., Hunslet, Leeds.

Steel Tools.

Saml. Buckley, St. Paul's Square, Birmingham.
Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.

Steel (Tool Steel).

Flockton, Tompkin & Co., Ltd. Newhall Steel Works, Sheffield.

Stokers.

Ed. Bennis & Co., Ltd., Bolton, Lancs.

Stone Breakers.

S. Pegg & Son, Alexander Street, Leicester.

Superheaters.

A. Bolton & Co., 40, Deansgate, Manchester

Testing Machines.

Denison, Saml., & Son, Ltd., Hunslet Moor, near Leeds.

Time Recorders.

Howard Bros., 40, Paradise Street, Liverpool, and 10cb, Queen Victoria Street, London, E.C.

Tubes.

Thomas Piggott & Co., Ltd., Spring Hill, Birmingham.
Tubes, Ltd., Birmingham.

Turbines.

Greenwood & Batley, Albion Works, Leeds.
S. Howes Co., 64, Mark Lane, London, E.C.

Typewriters.

Empire Typewriter Co., 77, Queen Victoria Street, London, E.C.
Yost Typewriter Co., 50, Holborn Viaduct, London, E.C.

Valves.

Holmes & Co., W. C., Huddersfield.
Hopkinson, J., & Co., Ltd., Britannia Works, Huddersfield
Hunt & Mitton, Crown Brass Works, Oozells Street North, Birmingham.
Scotch and Irish Oxygen Co., Ltd., Rosehill Works, Glasgow
Shaw, Joseph, Albert Works, Huddersfield.
Winn, Charles, & Co., St. Thomas Works, Birmingham.

Ventilating Appliances.

Matthews & Yates, Ltd., Swinton, Manchester

Water Softeners and Purifiers.

Lassen & Hjort, 52, Queen Victoria Street, London, E.C.

Wagons—Steam.

Thornycroft & Co., J. I., Ltd., Chiswick, London, W.
Yorkshire Patent Steam Wagon Co., Pepper Road, Hunslet, Leeds.

Weighing Apparatus.

W. & T. Avery, Ltd., Soho Foundry, Birmingham, England.
Denison, Saml., & Son, Ltd., Hunslet Moor, near Leeds.

Wells Light.

A. C. Wells & Co., 100A, Midland Road, St. Pancras, London, N.W.

Wire Ropes.

Bullivant & Co., Ltd., 72, Mark Lane, London, E.C.

Wire Working Machinery.

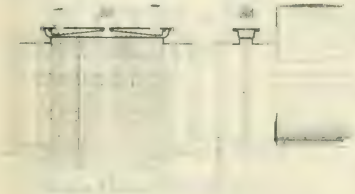
Ed. Brand, 35, Shakespeare Street, Manchester.

"Woodite."

"Woodite" Company, Mitcham, Surrey.

PAGE'S WEEKLY Miscellaneous

TO STEAM USERS.



OVER 400 WORKING,

Averaging a saving of **15** per cent. of coal and **30** per cent. of water. Repeat Orders coming in.

RELIEVE YOUR BOILERS.

Increase the efficiency of your Engines and improve Production by placing **BOLTON'S SUPERHEATER** in the Back or Downtake Flue.

To Dry and Superheat the Steam.

For Particulars write to Patentee and Sole Maker—

A. BOLTON & CO.,
Engineers and Contractors,
49, Deansgate, MANCHESTER.

YŌST

THE TYPEWRITER FOR BEAUTIFUL WORK.

Catalogue on Application.

THE YŌST TYPEWRITER CO., Ltd.,
50, Holborn Viaduct, London.

HERBERT W PERIAM LTD.

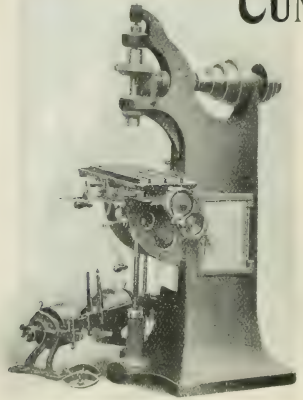
FLOODGATE ST WORKS
BIRMINGHAM.

TELEGRAPHIC ADDRESS
"FLOODGATE" BIRMINGHAM.

TELEPHONE Nº 373.

STOCK 250,000 GROSS

PAGE'S WEEKLY Machine Tools, &c.



A Size Vertical Milling Machines

CUNLIFFE & CROOM, Ltd.

Broughton Lane,
MANCHESTER,
ENGLAND.

Showroom :—
66, Victoria Street,
Manchester.

VERTICAL MILLING MACHINE.

AUTOMATIC FEED.

AUTOMATIC TRIP.

SPECIFICATION.

A size, as illustrated.

Size of Table ... 19½ x 8½ in

Traverses :—
Longitudinal, by hand 5½
Transverse, Automatic 12½
Vertical, by hand .. 12½

Code word, "Fire."

Price, as illustrated, **£40**

Extra for Plain Circular Table ... **£8**

Approx. weight, 10 cwt.

OIL SEED AND CAKE MILLS.

GRAB DREDGERS.

OIL REFINERIES.

Rose, Downs & Thompson, LTD.,

Old Foundry, HULL,
and
12, Mark Lane, LONDON, E.C.

WATER SOFTENING PLANT.

GREENWOOD & BATLEY, Ld.

LEEDS.

Machine Tools.

Dynamos & Motors.

De Laval's Patent Steam Turbines.

Telegrams: "MILLING. SHEFFIELD."
National Telephone No.: 985.

For the Latest and most Up-to-Date

PLATE BENDING MACHINE.

HEAVY = = MACHINE TOOLS = =

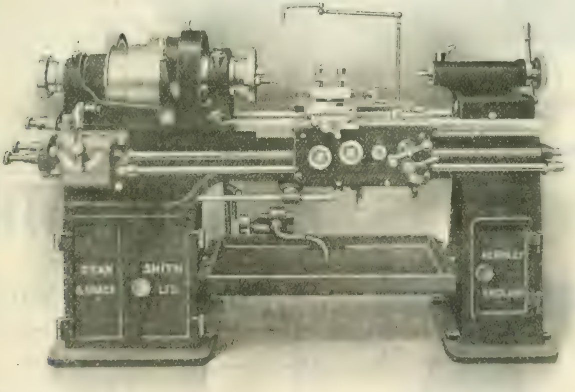
Also Special Lifting Jack for Electric Tramcars.

WRITE . .
GEORGE ADDY & Co.,
WAVERLEY WORKS, SHEFFIELD.

High-Speed Lathe

FOR ALL CLASSES OF WORK
are our sole Manufacture.

SPECIAL DESIGNS. UNIQUE FEATURES



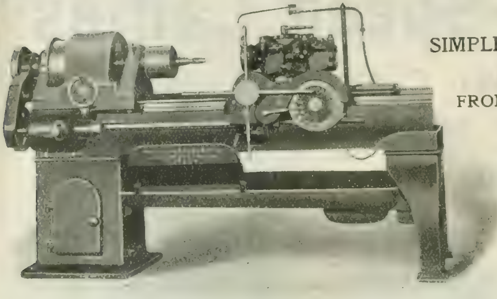
6 in. High Speed Lathe, with Friction Geared Head and Hollow Spindle, taking 2½ in dia Bar.

IF INTERESTED WRITE FOR OUR 1906 CATALOGUE.
IT WILL BE WORTH YOUR WHILE.

DEAN, SMITH & GRACE, Ltd., KEIGHLEY, England.

Agents for London: BUCK & HICKMAN, Ltd., Whitechapel Rd., E.
Agent for France: LOUIS BESSE, 30, Rue de Lappe, Paris.

TURRET LATHE SPECIALISTS.



Note the
SIMPLICITY of this LATHE.

DIRECT DRIVEN
FROM THE MAIN SHAFT.

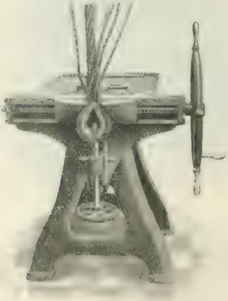
VARIABLE SPEED
HEADSTOCK.

The RACK and GUIDE direct under the cutting tool being completely covered.

ALL HANDLES and STOPS within reach of the Operator.
THE ONLY CORRECT GRIP CLUTCH.

Telegrams: "CRITERION, LINWOOD."
Telephone: 4Y JOHNSTONE.

ECLIPSE TOOL MFG. CO., Linwood, nr. Glasgow.



Cable Bending and Splicing Vise.

[illegible] DESCRIPTION

J. PARKINSON & SON,
SHIPLEY, ENGLAND.

Cables "TEMPLES, SHIPLEY." [illegible]

LANG'S LATHES
ARE NOW MADE IN
New Workshops
Replete with the Highest Class of Tools.
COME AND SEE THEM.
JOHN LANG & SONS, Johnstone, nr. Glasgow

HIGH SPEED LATHES
OUR SPECIALITY

HIGH-GRADE
MACHINES
only, in stock for
Immediate
Delivery.

Established [illegible]

C. REDMAN & SONS, Parkinson Lane, HALIFAX.

Hartness Automatic Die

The most satisfactory means yet devised for the production of screw threads.

This Die is not only used on all Hartness Flat Turret Lathes, but is now working on nearly all other makes of Turret Lathes. The new No. 4 is admirably suited to Automatic Machines.

Cam takes bearing direct on back of Chasers, insuring almost perfect lead.

Chasers can be instantly changed.

The adjustment is the easiest of any Die on the market.

All regular Chasers (or Screwing Dies), together with many special and Acme sizes, kept constantly in stock.

Write to-day, giving particulars of your requirements to

JONES & LAMSON MACHINE CO.

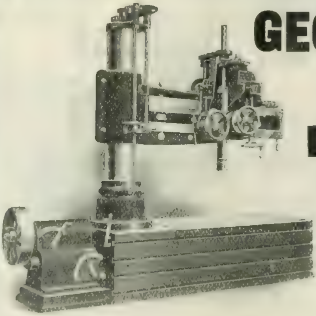
"Jubilee Buildings," 97, Queen Victoria Street,

LONDON.

Telegrams: "[illegible] London." Telephone No. [illegible]4 Bank, London.

Glasgow [illegible]

PAGE'S WEEKLY Machine Tools



GEORGE SWIFT,
Clarence, Iron Works,
HALIFAX, England.

Drilling Machines

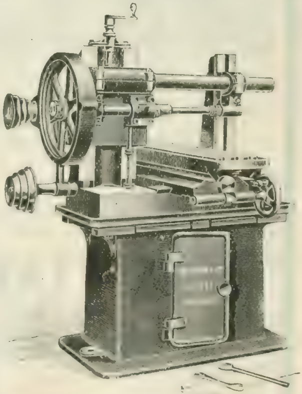
FOR HIGH-SPEED DRILLING.

Made in Three sizes, 4 ft. 6 in., 6 ft. 0 in., and
7 ft. 6 in.; either box or low base,
cone or geared drive and feed.

Telephone No. 4[illegible]7 Telegrams: "Swiftly, Halifax"
ESTABLISHED 1884.
Contractor to H.M. Government.

This machine can be seen working daily at my Works.

This is an illustration of my **6 ft. 0 in. Radial,** with 16 speeds, and 9 feeds, all obtained instantly by levers. There are several special features in this and my other tools, and I shall be glad to send full particulars on request.



BRADBURY'S

Newly Designed

Standard Milling Machine

For

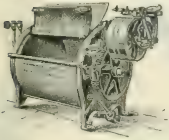
SPEED,
ACCURACY,
ADAPTABILITY,

IS **A1.**

Prices and Particulars from - -

BRADBURY & Co., Ltd., Wellington Works. *OLDHAM.*

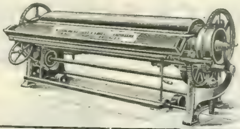
PAGE'S WEEKLY Machine Tools, &c.



LAUNDRY

MACHINERY

and Steam COOKING APPARATUS.



Please write for our New Catalogue, **N.**

Summerscales, Ltd., KEIGHLEY, ENGLAND.

HIGH-CLASS LATHES & RADIAL DRILLS.

Write for our Lists.

Telegrams: "Tools, Keighley."

D. MITCHELL & CO., Ltd., Parsonage Works KEIGHLEY.

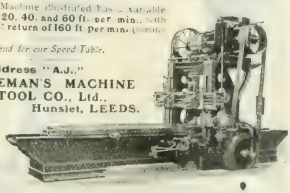
On War Office and India Office Lists.

BATEMAN THREE-SPEED PLANERS

The Machine illustrated has a variable cut of 20, 40, and 60 ft. per min., with constant return of 160 ft per min. [illegible]

Send for our Speed Table.

Address "A.J.,"
BATEMAN'S MACHINE TOOL CO., Ltd.,
Hunslet, LEEDS.



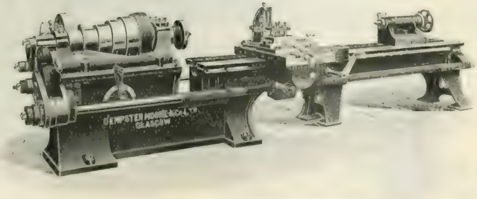
36 in. x 36 in. x 12 ft. with three-speed gear box.

Dempster, Moore & Co., Limited,

ENGINEERS, GLASGOW.

Modern Machine Tools of all Kinds.

SPECIALITY—LATHES FOR HIGH-SPEED CUTTING.



From a Photograph of a 9½-Inch High-Speed Lathe.

PAGE'S WEEKLY Machine Tools

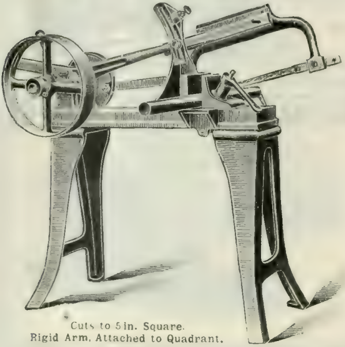
THE . . .

JOS. C. NICHOLSON TOOL CO.,

CITY ROAD TOOL WORKS, Newcastle-on-Tyne,

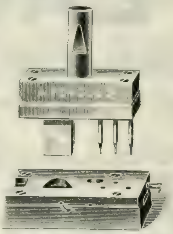
Makers of IMPROVED POWER

HACK SAW MACHINE



Cuts to 5 in. Square.
Rigid Arm, Attached to Quadrant.

Do You Want Any



PRESS TOOLS,
JIGS, CUTTERS,
RIMERS,
GAUGES?

If so, send your requirements, and

A. FENGL & Co.,

ALTRINCHAM,

Will submit design and price.

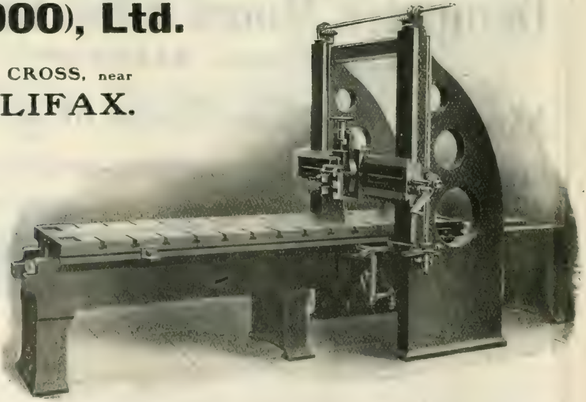
INVENTORS' MODELS WORKED OUT AND MANUFACTURED.

STAMPINGS TO THE TRADE.

Telegrams: Fengl Altrincham

Northern Engineering Co. (1900), Ltd.

KING CROSS, near
HALIFAX.



PLANING
MACHINE
from 2 feet
up to 8 feet
square.

PAGE'S WEEKLY Gearing, &c.

Spur Wheels

of all kinds, and in any material, cut
THEORETICALLY CORRECT.

RAW HIDE PINIONS
A SPECIALITY.

AD. AHLERS, Whitley Bay,
near NEWCASTLE-ON-TYNE,
ENGLAND.

DIXON'S IMPROVED METAL BUSHED

BUFFALO-RAW-HIDE PINIONS

ACKNOWLEDGED to be the most PERFECT and RELIABLE . . SILENT Gear in the World.

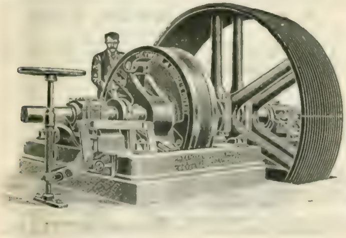
Particulars and Estimates sent on application.

W. L. DIXON & CO., 60, Percival St. C.-on-M., MANCHESTER.

Electric Hauling GEARS

Main and Tail Main Rope, Endless Rope, and Portable, Hoisting, and Hauling Gears.

M. B. WILD & CO., ARGYLE STREET NECHELLS
BIRMINGHAM.



HEYWOOD & BRIDGE'S

Patent Friction Clutches.
AND COMPLETE
Hauling and Gearing Installations.
The Ideal Clutch for Gas and Oil Engines.

[illegible]

SEND FOR 200-PAGE WORK, FREE.

Patentees & Sole Makers

DAVID BRIDGE & CO.,
Castleton Iron Works, ROCHDALE, Lancs
London Office: 35, QUEEN VICTORIA STREET, E.C.

Index to Advertisers.

Advertisements not appearing this week will be found by reference to the preceding or following issues, with the exception of those appearing monthly.

	PAGE
Addy, George & Co.	11
Ahlers, Ad.	—
Allen, Edgar & Co. Ltd	5
Allgemeine Elektricitäts Gesellschaft	—
Allis-Chalmers Co.	—
Anderson & Son, Ltd., D.	—
Angus, G., & Co. Ltd.	Inside Front Cover
Ashmore, Benson, Pease & Co.	—
Askham Bros & Wilson, Ltd.	5
Asquith, William, Ltd.	
Atlantic Press	—
Avery, Ltd., W. & T.	—
Babcock and Wilcox, Ltd.	3
Baldwin Locomotive Works	28
Bateman's Machine Tool Co.	10
Baynes, Charles	—
Beanland, Perkin & Co.	—
Beldam Packing and Rubber Co.	27
Benn, Sykes	25
Bennis & Co., Ltd., Ed.	33
Bertrams, Ltd.	5
Binney & Son	26
Bleichert & Co., A.	—
Blumann & Stern, Ltd.	—
Bolton & Co., A.	13
Booth & Bros., Ltd., Joseph	Inside Back Cover
Bradbury & Co., Ltd	18
Brand, Ed	—
Brett's Patent Lifter Co., Ltd.	4
Breuer, Schumacher & Co	—
Bridge & Co., David	21
British Advertiser Service Bureau	4
British Westinghouse Electric and Manufacturing Co. Ltd.	35
Broadbent & Sons, Ltd., Thos.	
Broadbent, T. W.	37
Brown, Andrew, & Co.	Inside Front Cover
Brown & May Ltd	—
Buckley, Samuel	—
Bullivant & Co., Ltd	9
Callender's Cable Construction Co., Ltd.	—
Cambridge Scientific Instrument Co., Ltd.	Inside Back Cover
Campbell Gas Engine Co.	25
Capell Fan Co.	—
Clarke's Crank & Forge Co., Ltd.	22
Clayton, Son, & Co., Ltd.	—
Concentric Condensers, Ltd.	—
Consolidated Pneumatic Tool Co., Ltd.	27
Cort, Arthur, & Co.	—
Crypto Electrical Co.	3
Cundall, Son & Co., Ltd.	23
Cunliffe & Croom, Ltd	14
Davidson & Co., Ltd	36
Davis, John, & Son (Derby) Ltd.	38
Davis & Primrose	3
Dean, Smith & Grace, Ltd.	15
Deighton's Patent Flue & Tube Co., Ltd.	—
Delange & Cie, Mc.	—
Delta Metal Co., Ltd.	
Dempster, Moore & Co. Ltd	10
Denison, S., & Son	
Dixon, W. F., & Co.	21
Dobbie-McInnes, Ltd.	3
Drum Engineering Co	—
Ebonestos Manufacturing Co.	5
Eclipse Tool Manufacturing Co.	19
Empire Typewriter Co.	—
Enke, Carl	—
Fairbanks Co.	—
Fairley & Sons, James	Outside Back Cover
Farnley Iron Co., Ltd.	—
Fengl, A. & Co.	20
Firth, Ltd., William	—
Fleming, Birkby & Goodall, Ltd.	—
Fockton, Tomlin & Co., Ltd.	—
Fowler, John & Co (Leeds) Ltd.	28
Fraser & Chalmers, Ltd.	—
Gent & Co., Ltd.	38
Gibbs, J., & Son	36
Gilmour, W. & O.	—
Glover & Co., M.	3
Green & Son, Ltd., E.	—
Greenwood & Batley, Ltd.	11
Greenwood, Thomas	2
Griffin & Co., Ltd., Charles	3
Hagan's Locomotive Works	—
Halden & Co., J.	—
Hall & Co., B. J.	—
Hall & Sons, Ltd., J. P.	—
Hannan & Buchanan	3
Hartley & Sugden	—
Hasenclever Söhne, C. W.	
Hathorn, Davey & Co., Ltd.	—
Head, Wrightson & Co., Ltd.	
Heenan & Froude	5
Hepton, W., and Son	31
Hill and Herbert, Ltd.	
Holmes & Co., W. C.	32
Hopkinson, J., & Co., Ltd.	31
Horsfall Destructor Co.	4
Howard Bros.	
Howes Co., S.	—
Hudswell, Clarke & Co., Ltd.	—
Hughes & Lancaster	4
Hughes, G. H.	3
Hunslet Engine Co.	—
Hunt and Mitton	2
Hyatt Roller Bearing Co.	
India Rubber, Gutta Percha, and Telegraph Works Co., Ltd.	—
Inglesant, T., & Sons Ltd.	—

John I. THORNYCROFT & CO., LTD.

Makers of . . All Types of Steam and Petrol Vehicles.

WORKS: CHISWICK, SOUTHAMPTON, BASINGSTOKE. MOTOR VEHICLE DEPT: HOGARTH LANE, CHISWICK, W.

FORGINGS.

Cranks and Forgings of Every Description in Stock.

See our Advertisement on February 16th.

CLARKE'S CRANK & FORGE CO., Ltd.

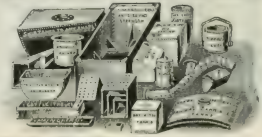
Telegrams: "CRANKS, LINCOLN." LINCOLN, England.

F. A. KEEP, JUXON, & CO.,

Manufacturers of

TANKS, CISTERNS

and CONSTRUCTIONAL IRONWORK.



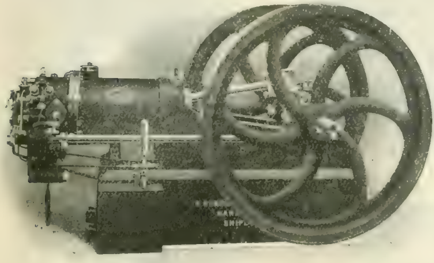
Forward Works, Barn Street, BIRMINGHAM.

PAGE'S WEEKLY Miscellaneous

THE "CUNDALL" PATENT OIL ENGINE,

THE MOST POPULAR OIL ENGINE.

In use in all Countries.



CUNDALL'S NEW SUCTION GAS ENGINE and GAS PRODUCER PLANT.

50 h.p. costs under 5d. per hour. Larger and smaller engines at the same rate, sizes 10 to 300 h.p.

CUNDALL, SONS, & CO., Ltd.,
SHIPLEY, YORKS.
Telegrams: "CUNDALL, SHIPLEY." Telephone No.: 4 SHIPLEY.

Offices and Showrooms:
LONDON:
20 & 22, St. Bride Street,
E.C.

SOMETHING NEW.

How to deal with Inward Invoices.

Does your present system involve the looking through a mass of detail before arriving at any required invoice?
If it does, then you are wasting your time.

YOU CANNOT AFFORD TO DO THIS.

THINK OF THE SAVING

if you adopt a system that will enable you to find any required invoice at once.

YOU OUGHT TO KNOW SOMETHING ABOUT THIS.

PARTICULARS OF

The Trading & Manufacturing Co., Ltd.,
C.I. DEPT.,
27 & 28, FLEET STREET, LONDON, E.C.

Index to Advertisers—(Contd.)

PAGE
Johnson and Phillips, Ltd. ... —
Jones and Lamson Machine Co. ... 17

Keep, F. A., Juxon & Co. ... 22
Kramos Ltd. ... 3
Krupp, Fried. ... —

Lancaster & Tonge, Ltd. ... -
Lang & Sons, John ... [illegible]
Lassen & Hjort ... 24
Leckenby, Benton & Co. ... —
Leeds Forge Co., Ltd. ... —
Lepard & Smiths, Ltd. ... —
Lorrain, J. G. ...
Luke & Spencer, Ltd. ... —
Lyle Co., Ltd. ...

Mabie, Todd & Bard ...
McLaren, J. & H. ... 28
McTear & Co., Ltd ... 4
Magnesia Coverings, Ltd. ... 42
Magnolia Anti-Friction Metal Co., Ltd ... —
Mallmann P. J. ... 28 & 32
Marion & Co., Ltd. ... 38
Matthews & Yates, Ltd. ... Inside Front Cover
Melville and Macalpine ...
Miller & Co., Hy. ... —
Mirrlees-Watson Co., Ltd. ... 29
Mitchell, D., & Co., Ltd. ... [illegible]
Mix & Genest ... 37
Mount-Haes, A. ... 3

Nalder Bros. & Thompson ... —
New Gutta Percha Co., Ltd. ... —
New Zealand Mines Record ...
Newton Bros. ...
Nicholson Tool Co., Jos. C. ... [illegible]
Niles-Bement-Pond Co. ... —
Noble & Lund, Ltd. ... —
Northern Engineering Co. (1900), Ltd. ... 20
Northern Railway of France ... 40

Parker Foundry Co. ... 25
Parkinson & Son, J. ... [illegible]
Pegg & Sons, S. ... 4
Perman, Ltd., H. W. ... [illegible]
Phœnix Dynamo Mfg. Co., Ltd. ... 30
Phosphor Bronze Co., Ltd. ... —
Piggott & Co., Ltd., Thos. ... 5
Pohlig, J., Ltd. ... 27
Positive Rotary Pumps, Ltd ...
Pratt & Whitney Co. ...
Pryor & Son, Edward
Purden & Sons, John ... Outside Back Cover

Quaker City Rubber Co. ... 26

Redfern & Co., S. ... 24
Redman & Sons, C. ... 16
Reid Gear Co. ...
Reliance Lubricating Oil Co. ... 5
Rice & Co. (Leeds) Ltd ... —
Richter, Gustav ...
Riter-Conley Manufacturing Co. ... 25
Robinson & Co., Ltd., T. D. ... 4
Rockwell-Wabash Co., Ltd. ... 4[illegible]
Roller, A. ... 41
Rose, Downs & Thompson, Ltd ... 14
Rubber Stamp Co ... 41

Samson & Co. ... 34
Sankey & Son, J. H. ... —
Schieren & Co., Chas. A. ...
Schnicke, H. F. ... -
Scotch and Irish Oxygen Co., Ltd. ... —
Scott, E., & Mountain, Ltd. ... 37
Scott, Walter, Ltd. ... 4
Shannon, Ltd. ...
Shaw, Joseph ... 31
Smith, Ltd., G. F. ... —
Smith & Sons, of Saltley, Ltd., Thomas ... —
South-Eastern & Chatham Railway ... 40
Spon, E. & F. N. ... —
Spottiswoode & Co., Ltd. ...
Stafford, Arthur, & Co. ... 41
Stamm, W. ... —
Stirling Boiler Co., Ltd. ... Outside Back Cover
Süddeutsche Kabelwerke, A.-G. ... —
Summerscales & Sons, Ltd., W. ... [illegible]
Swain & Son, Ltd., John ... [illegible]
Swift, George ... [illegible]

Taylor & Challen, Ltd. ... [illegible]
Temperley Transporter Co ... 4
Thom, John Z. ... [illegible]
Thompson, John ...
Thornycroft & Co., Ltd., John I. ... [illegible]
Tomey, J. & Sons ... 4
Trading and Manufacturing Co., Ltd. ... [illegible]
Treasure & Co., J. B. ... 42
Tubes, Ltd. ... 42
Turner, Atherton & Co. ... —

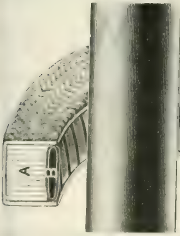
United States Metallic Packing Co., Ltd. ... 24

Valor Co., Ltd. ...
Vauxhall and West Hydraulic Engineering Co., Ltd. ... —

Ward & Co., H. W. ... —
Ward, T. W. ... 5
Waygood & Co., Ltd. ... —
Weaver & Co., B. ... -
Weise & Monski ... 33
Wells & Co., A. C. ... 11
West & Co., Ltd., H. J. ... -
West Hydraulic Engineering Co. ... —
West Pascagoula Creosoting Works ... —
Westinghouse Electric and Manufacturing Co., Ltd., The British ... [illegible]
Wild, M. B., & Co. ... [illegible]
Williams & Co., J. H. ... 4
Winn & Co., Charles ... 37
"Woodite" Co. ...
Wrigley & Co., Ltd., E. G. ... —

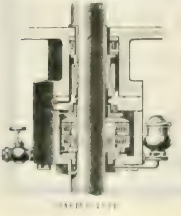
Yorkshire Patent Steam Wagon Co. ... —
Yorkshire Machine Tool and Engineering Works ... —
Yost Typewriter Co., Ltd. ... 13

Zeitz & Co. ... 5



Patent Flexible
METALLIC FACED
PACKING
For all
Pressures.

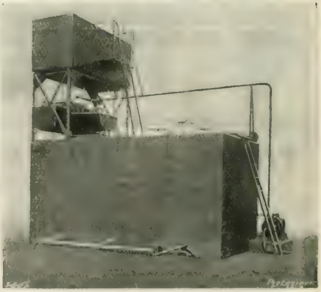
S. REDFERN,
Swan Lane,
New Brown St.,
MANCHESTER.



THE
PACKING
OF
PACKINGS
Used by
British, United States, Dutch,
Spanish, Japanese, etc.,
Navies.

UNITED STATES METALLIC
PACKING CO., LTD.,
BRADFORD.

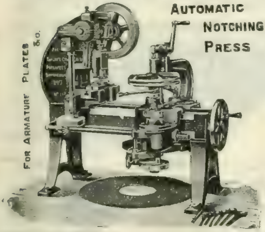
WATER PURIFICATION.

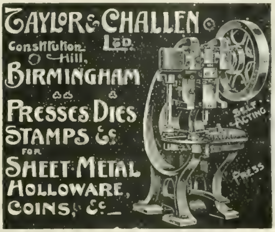


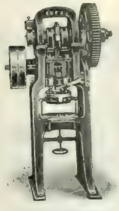
Water Purification is our Speciality.
1,600 PLANTS in Operation.

LASSEN & HJORT,
Engineers,
52, QUEEN VICTORIA STREET.
Telephone [illegible] CENTRAL. Telegrams "TENTWORTH, LONDON."

PAGE'S WEEKLY Miscellaneous



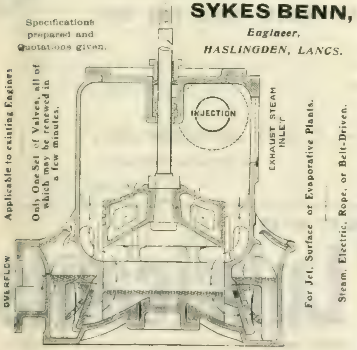

TAYLOR & CHALLEN LTD.
Constitution Hill,
BIRMINGHAM
PRESSES DIES
STAMPS &c.
FOR
SHEET METAL
HOLLOWARE,
COINS, &c.
SELF ACTING
PRESS


DRAWING PRESS.

Benn's Patent Combined Air-Pump, Condenser, and Delivery Box.

SYKES BENN,
Engineer,
HASLINGDEN, LANCS.

Specifications prepared and Quotations given.



Applicable to existing Engines

Only One Set of Valves, all of which may be renewed in a few minutes.

For Jet, Surface or Evaporative Plants.

Steam, Electric, Rope, or Belt-Driven.

INDEPENDENT
CONDENSING PLANTS

"CAMPBELL"
GAS ENGINES & SUCTION PLANTS,
OIL ENGINES & PUMPS.

SOLE MAKERS—
THE CAMPBELL GAS ENGINE CO., *Limited,*
Halifax, England.

London Office—
114, Tooley Street, S.E.

Glasgow Office—
104, Bath Street.

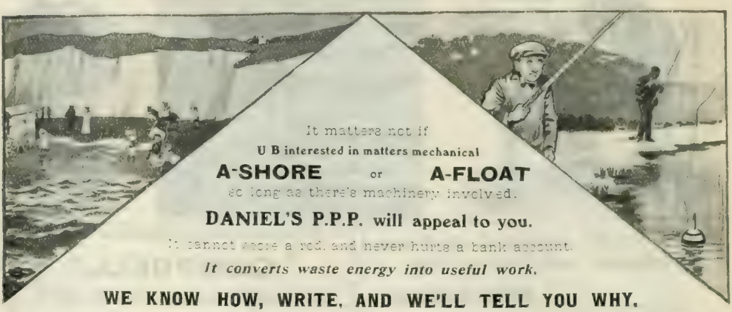
MALLEABLE IRON & STEEL CASTINGS FOR ENGINEERS & TOOL MAKERS
TO MACHINE CLEAN & BRIGHT ALL OVER.
PARKER FOUNDRY CO. DERBY
ON ADMIRALTY LIST.

STEEL CONSTRUCTION
IN ALL BRANCHES
Buildings Designed and Erected in all Parts of the World.

ROOF FRAMES, TRUSSES AND GIRDERS.
BLAST FURNACES AND STEEL WORKS, CUPOLAS, LADLES, CONVERTERS.
BOILERS, TANKS, AND HEAVY PLATE WORK
GAS HOLDERS, PURIFIERS, ETC.,
OPEN HEARTH FURNACE CASINGS.
CHIMNEYS, RIVETED PIPE, CORRUGATED IRON.

RITER-CONLEY MFG. CO., PITTSBURG, P.A., U.S.A.
New York Office: 39-41, Cortlandt Street.

PAGE'S WEEKLY Packings, Lubricants, &c.



It matters not if
U B interested in matters mechanical
A-SHORE or **A-FLOAT**
so long as there's machinery involved.
DANIEL'S P.P.P. will appeal to you.
It cannot score a rod, and never hurts a bank account.
It converts waste energy into useful work.
WE KNOW HOW, WRITE, AND WE'LL TELL YOU WHY.

N.B.—If this meets the ***i*** of ***1*** who uses a spanner on his pump, engine, or compressor glands, he will hear something to his advantage about AUTOMATIC P.P.P. PACKING by communicating with—

QUAKER CITY RUBBER CO.,
4, Lloyd's Avenue,
LONDON, E.C.

Ronald Trist & Co.,
General Managers for United Kingdom.

BINNEY'S

"Asblubric" Lubricants

REGISTERED TRADE MARK.

If you require REALLY FIRST-CLASS LUBRICANTS, or if you have any trouble with what you may be using, write to BINNEY & SON, stating for what purpose required, and they will be glad to forward samples for trial and full particulars of their "ASBLUBRIC" LUBRICANTS, which do not fail to give satisfaction.

Also at
BIRMINGHAM, LEEDS,
GLASGOW, and COVENTRY.

BINNEY & SON,
CATHERINE STREET, CITY ROAD, **LONDON.**
(L Dept.)

THE BELDAM PACKING AND RUBBER Co
93 & 94 GRACECHURCH St LONDON E.C
TELEGRAPHIC ADDRESS "CORRUGATED, LONDON"
[illegible] TO THE ADMIRALTY & FOREIGN GOVERNMENTS, ALSO TO THE LEADING STEAMSHIP & OTHER COMPANIES.
THE R.M.S. "CEDRIC" (THE LARGEST STEAMER AFLOAT) IS FITTED WITH BELDAM'S SPRING NECK BUSHES & TUBULAR PACKING &
WEAVERS & MANUFACTURERS OF EVERY DESCRIPTION OF ASBESTOS & RUBBER GOODS
REGISTERED TRADE MARK

PAGE'S WEEKLY

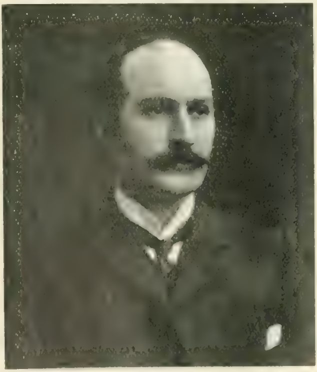
An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

VOL. VIII. LONDON, FRIDAY, JANUARY 26, 1906 No. 72.

The Offices of "Page's Weekly," Wednesday Evening.

MR. JAMES SWINBURNE is a rara avis. He knows how to fly through the intricacies of a dull subject without becoming dull himself. That he will excuse our ornithological tribute we have no doubt, for in a recent address on "Efficiencies" he draws upon the biological kingdom himself, by way of showing that if the accessories of a power station are complicated, a "working drawing" of the humble horse, which they really represent, is not such a very simple matter either. The address referred to was given to the Manchester Students of the Institution of Electrical Engineers, and at the outset Mr. Swinburne explained that the title was put in the plural to prevent any misunderstanding as to its nature. "Efficiency" is, he believes, "a catchword in party politics, and is, therefore, largely employed in connection with people who have no real output at all." This, by the way, was before Manchester gave its political verdict.

Mr. Swinburne shows that the question of efficiencies can with advantage be looked at from a money point of view as well as merely in connection with the scientific production of the power. Indeed, he goes so far as to say that "all engineering" is a question of money—a matter upon which there may certainly be two opinions. Passing over, therefore, this airy excursion into political economy we arrive at a very instructive series of diagrams which tell us a good deal about efficiencies at a glance. They were prepared by Mr. Walter Claypoole, lecturer on electric lighting and power distribution at Croydon Polytechnic, whose services are freely acknowledged by Mr. Swinburne. The question of wastage in the production of power is so important, and opens so many fields for inquiry that we reproduce several of them, together with extracts from Mr. Swinburne's explanatory remarks.



PROFESSOR [illegible] CORMACK, B.SC.

Who will deliver [illegible] honorary member's lecture this evening at a meeting of the Junior Institution of Engineers.

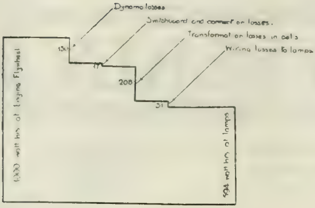

Dynamo losses
Switchboard and connection losses.
Transformation losses in cells
Wiring losses to lamps
1000 watt hrs of Engine Flywheel
150
17
208
31
594 watt hrs of lamps

FIG. 2.

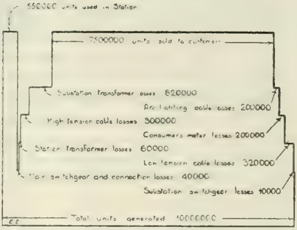
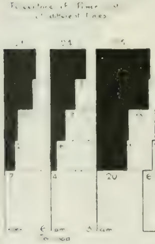
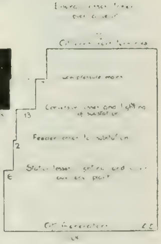

550000 units used in Station
7500000 units sold to customers
Substation transformer losses 620000
Arc lighting cable losses 200000
High tension cable losses 300000
Consumers meter losses 200000
Station transformer losses 60000
Low tension cable losses 320000
Main switchgear and connection losses 40000
Substation switchgear losses 10000
Total units generated 10000000
EE

FIG. 3.




Low pressure mains
Conversion losses and lighting of substation
13
Feeder losses to substation
2
Station losses
6
EE

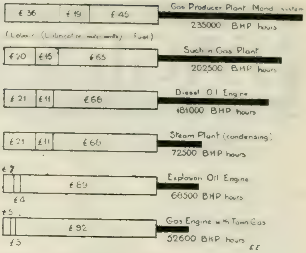


FIG. 6.

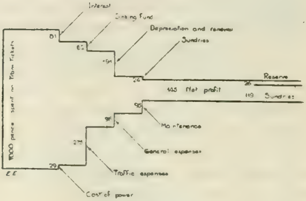


FIG. 7.

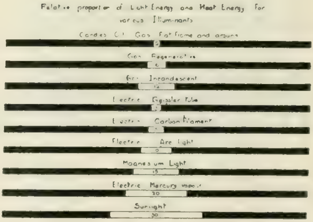


FIG. 8.

Fig. 1 is a diagram of an engine and boiler, the energy of the coal being taken at 100 to begin with. In a boiler 7 per cent. is lost in the hot ashes and imperfect combustion, 15 per cent. escapes up the chimney and 78 per cent. goes into the boiler for raising steam. Of the 78 per cent. available for steam raising there is lost 15 by radiation, priming, and auxiliaries, but five per cent. has been added by the heated feed water, making up 68 supplied to the engine. This wastes 1 by friction and rejects 55 in the exhaust, turning out only 7 per cent. as useful work. It might be supposed that there is enormous room for improvement in the steam engine. It looks as if all the loss is due to the engine, which gets 68 per cent. and only gives out 7 per cent., but one must not be hard upon the engine. It is turning out work or high-grade energy, and it is receiving heat, or low-grade energy. This engine is probably taking in steam at about 450 deg. C. absolute and rejecting it at about 375 deg. C., so that it could, if perfect, only turn out $68 \times 75 \div 450 = 11{\cdot}3$; so it is not really doing so badly.

The real loss is between the fuel and the boiler, and it is not loss of energy, but loss of availability. Though the chemical is low grade energy, it has such a high chemical temperature that 97 per cent. is theoretically available, but we cannot run a boiler and engine between 3,000 deg. and 4,000 deg. C. Engineers are always trying to improve the results by using higher and higher temperatures, but as you cannot use the pressures that would then correspond with saturated steam, you can only superheat. This does not mean that most of the heat is taken in at the high temperature, and the resulting gain is chiefly due to such things as reduction of cylinder condensation. There are great practical difficulties in reducing the lower temperature. The condenser reduces it to about 100 deg. C., or 372 deg. C.A.; but even then the steam is not completely expanded, and blows into the condenser under pressure. The efficiency has been raised more recently by reducing the lower temperature limit by means of sulphur dioxide. It is doubtful who was the first to propose this. Rayleigh suggested it as early as 1876. It is being put into practice now in Germany.

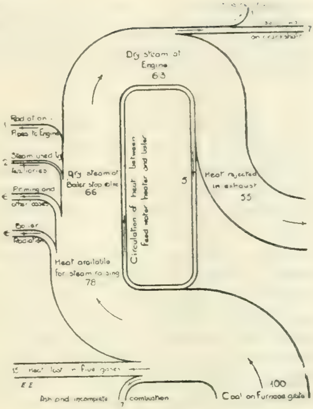


FIG. 1.

Fig. 2 is a simple diagram of a private house installation with batteries. It starts where the last diagram left off, but as it is supposed to be a small installation, the steam generator would be much less efficient. One would expect to find most of the power delivered to the dynamo going to the lamps, but the diagram shows a big loss in the secondary batteries. The dynamo losses are rather heavy because the dynamo is small, and it is losing power during the charging of the batteries, as well as while the lights are on. The diagram would have looked better if there were no cells and the dynamo were larger, and only working when the light is needed; but this means greater capital cost and greater expense in labour. To make the diagram really complete, it ought to have shown that too. The diagram shows, however, how inefficient small dynamos are under such circumstances compared with the performance of large machines with good load factors. The dynamo is, however, the most efficient machine for converting one kind of power into another itself, and there is not much room for improvement. There is no feat in which the electrical engineer takes more pride than the production of the modern highly efficient dynamo. The secondary battery has absorbed the energy of many able men for many years without giving any adequate return. It is very little better than it was 20 years ago, and it does not look as if the lead accumulator was capable of much further improvement.

The next diagram (fig. 3) shows the loss between the station switchboard and the consumer's terminals. What is really wanted is a lamp which will stand constant variations of pressure, to reduce, not so much the waste in mains, which shows in the diagram as the capital cost, which is not shown there. It might be thought that the new metallic wire lamps would do, because the temperature coefficient of wire is positive, and is fairly large near the melting point. The trouble is that it is not large enough to protect the lamps, especially as they are run at high efficiencies, and therefore high temperatures, so that there is not very much margin.

The right-hand part of fig. 4 is a rough diagram of the yearly losses in the Metropolitan system, supplying several London areas from Willesden. I am indebted to Mr. Highfield for the figures. It will be seen that transformers are very efficient, and when they can be cut out at light loads, so that the transformers in use are always well loaded, the efficiency can be made very high. The diagram is also a little deceptive, because it takes no notice of the time at which the energy is wasted. Energy wasted at the time of station full load is serious, because if it were not wasted it might be sold, or else the station might be a little smaller in proportion. But most of the waste in transformers is at light loads, and it costs very little extra to generate extra power at times of light load. It costs nothing extra in capital, superintendence, or labour, and it does not cost much in coal, for the boilers have to be kept hot and some engines have to be kept running in any case. These points have to be borne in mind in considering the meaning of such diagrams. It will be seen that there is a loss of 6 per cent. in "station losses," only 2 per cent. feeder losses to sub-station, and 13 per cent. conversion losses and lighting of the sub-stations. These are for the year. They alter from time to time, so the wastes are shown black to the left for three representative times. Thus the station losses are 7 per cent. at noon, 4 per cent. at top load, and 20 per cent. at three in the morning, and so on. This is because the losses do not vary in proportion to the loads. Through the various sources of waste energy, the final result is that there is 21 per cent loss at noon, or 79 per cent. efficiency, and 74 per cent. efficiency at 6 p.m., and up to 65 at 3 a.m., which is astonishingly good when the system is considered.

The next diagram (fig. 5) belongs to a different class. The consumer pays £100 to the supply company. How is it spent? Most people would be inclined to say that about £90 went to buy coal and the rest was profit. Instead of £100—an amount which is larger than most people care to pay, even for the electric light—will take 1,000 pence. Of this, only 66 goes to coal and cartage of coal; 19 is devoted to oil waste, water, and stores; only 70 to workmen's wages; 57 go to repairs and maintenance. Practically 400 go to interest and special expenditure and sinking fund.

Fig. 6 shows where a sum of money goes when spent on generation of power by steam, town gas, producer gas, oil and petrol. The most striking differences are in the proportions of labour, materials, and fuel.

One of the most curious aspects of the tramway and railway question is that in one sense the efficiency is zero. In a way it takes no work to transport a person from one place to another on the level, yet, in fact all this

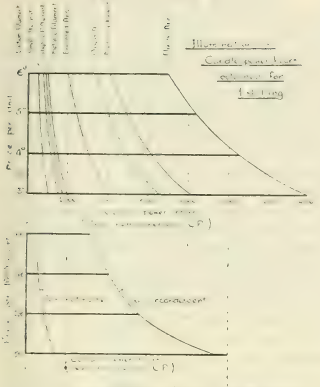


FIG. 10.

expenditure is necessary. One of the most striking anomalies is that nearly all the energy is wasted, not in carrying human beings, but in moving about the cars themselves.

Fig. 7 shows what the tramway company does with the money it collects. Attention is called to the very small proportion that goes to pay for power—under 3 per cent. The traffic expenses come to nearly ten times the cost of power. The depreciation and renewal come to nearly 20 per cent., and this is in addition to the sinking fund of 6 per cent. (this is 6 per cent. of the money received for tickets; it must not be confused with a 6 per cent. sinking fund). There is a net profit of 14½ per cent. This is again 14½ per cent. on the money taken—it does not mean 14½ per cent. on the capital at all.

Fig. 8 is interesting as it shows, or tends to show, the proportion of the energy given to the illuminant that comes out as light. It does not seem to me quite correct. Mr. Swinburne thinks that the candle and oil lamp would give much less than 2 per cent. The arc lamp seems to me to be put too low, and the sunlight seems too low for the radiation in space, and too high for the radiation if it has been through the atmosphere. This diagram is taken from a table given by Prof. V. B. Lewes. Fig. 10 shows how many candle hours you can get for a shilling paid to the company with different illuminants.

The mineral output of the Transvaal for 1905 is valued at £22,688,675, of which amount diamonds account for £922,780. The total increase in value as compared with 1904 amounts to £4,544,558. The report of the Government mining engineer for the year ended June 30th last states that the salaries and wages paid in the whole mining industry amounted to £8,996,121, of which amount £5,660,493 was paid to whites. The increases over the previous year amounted to £2,947,786 and £866,130 respectively. Native wages absorbed £2,990,306, and Chinese wages £345,322, being an average monthly wage of 52s. for natives and 33s. 6d. for Chinese.

SIR MARCUS SAMUEL,

Who delivered the presidential address before the Institute of Marine Engineers on Monday last.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

DAVIDGE PAGE, Editor.

Clun House, Surrey Street, Strand, London, W.C.
Telephone No 3349 GERRARD.
Telegraphic and Cable Address: "SINEWY, LONDON."

Correspondence *is invited from any person upon subjects of interest to the engineering community. In all cases this must be accompanied by full name and address of the writer, not necessarily for publication but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

The Editor does not hold himself responsible for the opinions expressed by individual contributors, nor does he necessarily identify himself with their views.

Subscription Rates per Year.

Post free to any part of Great Britain and Ireland—in advance, 20s. for twelve months.

To countries in the Postal union, including postage—in advance, 25s. for twelve months.

Sample Copies: United Kingdom, 6d., post free; Abroad, 8½d. post free.

Remittances should be made payable to PAGE'S WEEKLY and may be forwarded by Cheque, Money Order, Draft, Post Office Orders or Registered Letter. Cheques should be crossed "LONDON & COUNTY BANK, Covent Garden Branch." P.O.'s and P.O.O.'s to be made payable at East Strand Post Office, London, W.C. When a change of address is notified, both the new and old addresses should be given. All orders must be accompanied by remittance, and no subscription will be continued after expiration unless by special arrangement. Subscribers are requested to give information of any irregularity in receiving the Weekly.

When Foreign Subscriptions are sent by Post Office Orders advice should be sent to the Publisher.

Foreign and Colonial Subscribers receiving incomplete copies through newsagents, are requested to communicate the fact to the Publisher, together with the agent's name and address.

The whole of the contents of this journal are copyright, and full rights are reserved.

MEETINGS, ETC., FOR THE ENSUING WEEK.

FRIDAY, JAN. 26.—Civil Engineers, 25, Great George Street, S.W., 8 p.m. (Students' Meeting.) 1. Mr. T. R. Grigson, "Prince of Wales Pier, Falmouth." 2. Mr. H. O. H Etheridge, "Ferro-Concrete Pier at Purfleet."—Physical, Royal College of Science, South Kensington S.W., 5 p.m.—Junior Institution of Engineers, Westminster Palace Hotel, 8 p.m. Lecture by Prof. J. D. Cormack on "Notes on Boiler Trials."

SATURDAY, JAN. 27.—Junior Institution of Engineers, 3 p.m. Visit to the Engineering Laboratories of University College Gower Street.

MONDAY, JAN. 29.—Society of Arts, Cantor Lecture by Sir William White on "Modern Warships."

TUESDAY, JAN. 30.—Institution of Civil Engineers, Great George Street 8 p.m.

THURSDAY, FEB. 1.—Royal Society, Burlington House, 4 p.m. Society of Arts 8 p.m. Third Howard Lecture by Professor S. J. Thompson.

FRIDAY, FEB. 2.—Royal Institution, 9 p.m. Professor S. J. Thompson on "The Electric Production of Nitrate from the Atmosphere."—The Junior Institution of Engineers, Westminster Palace Hotel 8 p.m. Paper "Some Recent Electrical Engineering Measuring Instruments," by Kenelm Edgcumbe, M.I.E.E.

NEWS ITEMS.

Mr. W. H. Lindley is designing and carrying out a waterworks and sewerage scheme for the municipality of Bucharest.

Dr. Silvanus Thompson, at the Society of Arts yesterday contributed a further Howard lecture on "High Speed Electric Machinery, with special reference to steam turbine machines." A report of the first lecture will be found on page 206.

Sir William White gives the first of a series of five Cantor lectures on "Modern Warships" on Monday evening at the Society of Arts. The lecture will cover the characteristic features of warships, materials of construction, structural arrangements, and the operations of building and launching.

Mr. Wilson Worsdell, J.P., chief mechanical engineer of the North-Eastern Railway Company, has been presented with a solid silver cigar case with gold centrepiece, etc., by the retired engine drivers of Gateshead as a token of their esteem and appreciation. The presentation followed a dinner, at which Mr. Worsdell entertained twenty-seven veteran drivers and invited guests.

Sir Charles Metcalfe, recently interviewed on the progress of the Cape to Cairo Railway, is reported to have said :—"A fortnight ago the rails reached the Kafue River, 260 miles beyond the Victoria Falls and at this point a bridge 1,600 ft. long is being constructed to cross the stream. Beyond the Kafue the earthworks are nearly finished, for a further distance of seventy miles, so that we hope that the line will reach the Broken Hill zinc and lead mines by June. There will thus be continuous communication from Capetown to a point 374 miles north of the Zambesi."

CONTENTS.

PAGE
Editorial Notes (*Illustrated*) .. 169
News Items (*Illustrated*) 174
Worm Contact. By Robert A Bruce (*Illustrated*) .. 177
The Future of our Canals (*Illustrated*) . 185
Hamburg Port Improvements (*Illustrated*) 189
A New Temperature Recorder (*Illustrated*) . . 191
Our Weekly Biography: Maurice Wilson, (*Port.*), A.M.Inst.C.E., President of the Society of Engineers 192
Open Centre Lathe for High-Speed Steel. By Messrs. Leckenby, Benton and Co., Halifax (*Illustrated*) . .. 193
The Magnetic Concentration of Iron Sands from the Lower St. Lawrence. Notes on some recent experiments. By John F Robertson, M.Sc., [illegible] (*Illus.*) 194
Swansea Destructor [illegible]
The Garvins Falls Dam, Canal, and Hydro-Electric Plant, Bow, N.H. By George G. Shedd (*Illus.*).. [illegible]
Correspondence . 201
Technical Society Notes.. .. 202
New Double-ended "Yarrow" Boiler (*Illus.*) [illegible]
Howard Lectures .. 206
Naval Notes .... [illegible]
Shipbuilding Notes .. . [illegible]
Contractors News .. . [illegible]
Share List .... [illegible]
Home Metal Market (*Chart*) [illegible]
Price Current [illegible]
Openings for Trade Abroad 221
Abridged Specifications (*Illustrated*) 222
New Publications [illegible]
New Catalogues [illegible]

Controller for Electric Cranes.

A controller specially designed for electric cranes is illustrated herewith by courtesy of the makers, Messrs. Joseph Adamson and Co., of Hyde, Cheshire. It is made in four standard sizes, ranging from 5 h.p. at 100 volts to 90 h.p. at 500 volts.

Fig. 1 shows the controller complete with hand lever suitable for fixing in a cage, while in fig. 2, the controllers are fixed on the side of a crane and arranged for working from the floor of the shop.

The reversing switch is of the faceplate pattern and consists of a strong slate base upon which are mounted a large number of drop-forged copper contacts, of ample area to ensure low working current destiny. The slate base is secured in a strong cast-iron frame designed also to give efficient ventilation for the resistances. The resistances are self-contained, thus avoiding long connections between the contacts and the resistances. For insulating purposes only non-inflammable materials of high electrical resistance are used throughout. All the parts are interchangeable.

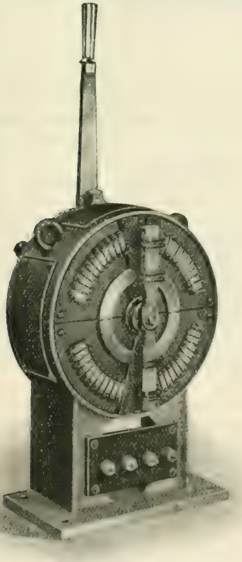


FIG. 1. ELECTRIC CRANE CONTROLLER

Of compact and accessible construction, the controller is fitted with a powerful magnetic blowout, the field of which is concentrated behind the contacts. A large number of contacts are provided to ensure a low voltage between each step, while care has been taken to insure proper graduation of resistance between the contacts to prevent any excessive rush of current and consequent jumps in speed of the motor when passing from one contact to another. The resistances are made up of special strip wound spirally and insulated throughout with mica.

The London School of Marine Engineering.

The London County Council School of Marine Engineering, formally opened this week at High Street, Poplar, already boasts of nearly 400 students. It has been erected at a cost of £26,000 for building and equipment, while the site was valued at £3,500. The general management of the school has been undertaken by Mr. H. A. Garratt, a member of the Institute of Naval Architects and an associate of the Institute of Civil Engineers, with a capable staff of assistants. Instruction will be given in seamanship and navigation, including nautical astronomy for deck officers and petty officers in the mercantile marine; marine engineering; naval architecture and principles of propulsion; general mechanical engineering; electrical engineering; especially in relation to the application of electricity to lighting and the transmission of power on board ship; pattern making; carpentry and joinery and wood working generally; theoretical and practical chemistry, physics, and experimental mechanics.

New Vessels under Construction.

Lloyd's Register of Shipping returns the number of vessels under construction in the United Kingdom, exclusive of warships, at the close of the quarter ended December 31st, 1905, as 515, amounting to 1,355,756 gross tons. Of this total, 487 vessels were steamers of 1,350,839 tons gross, against 371 steamers with 1,037,788 gross tonnage on December 31st, 1904. The tonnage under construction has shown a steady increase since December, 1903, and the present figures are within 57,000 tons of the total reached in September, 1901, which is the highest on record.

Indian Railway Projects.

The Government of Eastern Bengal and Assam, according to the Pioneer, is acquiring a considerable [illegible] of railway from [illegible]

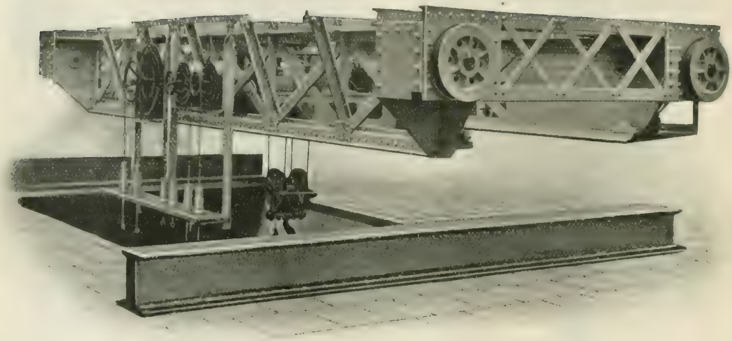


FIG. 2. CONTROLLERS ARRANGED FOR WORKING BY MEANS OF ROPES FROM THE FLOOR.

station on the Assam-Bengal Railway, to Bhairab Bajaor, on the Megna River. The construction of this branch line will mark an important step in the development of railway communications in Eastern Bengal. Surveys are also about to be made for a line which will link Calcutta with Tezpur, in Upper Assam, by connecting the latter place with the Rangya and Baihati Stations, on the Gauhati extension of the Eastern Bengal Railway. According to the same authority, surveys have been sanctioned in the United Provinces for a line from Rosa, on the Oudh and Rohilkhand Railway to Sitapur, on the Lucknow Bareilly State Railway, a distance of 52 miles, and from Azamgarh to Goshaingunj, on the loop line of the Oudh and Rohilkhand Railway, a distance of about 58 miles.

The London Traffic Problem.

At Tuesday's meeting of the London County Council, it was agreed on the motion of Mr. Cleland, M.P., "that it be referred to the General Purposes Committee to consider and report whether, having regard to the fact that the work included in the references to the Highways, Building Acts, Improvements, Rivers and Bridges Committees is intimately connected with the provision of adequate facilities to cope with the traffic problem of London, the time has not arrived when, with a view to co-ordinate the various methods of dealing with this problem, it is desirable to establish a Traffic Committee."

The Panama Canal.

An investigation of the administration's management of the Panama Canal has been commenced by the Senate's Canal Committee, behind closed doors. The chief engineer, Mr. Stevens, was the first witness examined, and the inquiry had reference chiefly to conditions on the Isthmns. Mr. Stevens vigorously denied the statement made by the well-known American writer in a recent article condemning the canal management. Reuter's correspondent states that Mr. Stevens has informed the committee that Chinese labour is the only kind that can be used effectually in digging the canal.

A feature of special interest connected with the Graduates' Association of the Institution of Mechanical Engineers is a lecture to be given by Prof. W. C. Unwin, F.R.S., on the 12th prox., on "The Niagara Power Stations."

The Delta Metal Company, Ltd., of London and Birmingham, have closed their works at Pomeroy Street, New Cross, S.E., and will in future carry on their London business at East Greenwich, London, S.E.

The fifth Automobile Show wlll be held at the Crystal Palace from the 26th inst. until February 3rd inclusive.

WORM CONTACT.

By Robert A. Bruce.

EXPERIMENTAL investigation of the actions involved in worm-gearing has been singularly incomplete, but many writers have contributed to the theory of the subject. The present review of the question is intended rather to cover some of the more obvious omissions than to give a complete account of this form of gearing. A complete explanation would be impossible within the compass of a paper of reasonable length.

In the case of worm-gearing, the motions of rotation are about axes at right angles, and at the outset some device or artifice is required in order to bring the motions within range of plane diagrams. If attention be confined to any plane section a worm parallel to its axis, and the worm itself is rotated whilst the plane remains stationary, it is found that the profile of the section remains the same, but changes its position, advancing uniformly in a direction parallel to the axis at a definite rate, one revolution of the worm causing a translation parallel to the axis through a distance equal to the pitch.

Thus fig. 1 (page 178) represents a transverse section of a double-threaded RH worm, 4 in. outside diameter, 3 in. pitch diameter, 4 in. pitch. The section on a plane through the axis is shown in fig. 2, the observer being situated on the left of BB in fig. 1. The profile remains unchanged in shape as the worm rotates, but is translated from right to left as shown by the arrow. Figs. 3 and 4 are respectively sections by planes AA and CC, the observer being situated in each case to the left of AA and CC in fig. 1. As the worm rotates the same constancy of form, combined with a definite rate of translation, is seen to occur. In order to study the action of a worm-gearing with a worm-wheel, it is only necessary to choose BB so that it is the plane through the centre of the worm-wheel. AA, BB, and CC will then be definite planes in the worm-wheel perpendicular to the axis about which it rotates. The tooth-profiles of the worm-wheel in any particular plane, such as BB must be such that they would correctly gear with a rack of the form *bbb*, in fig. 2. Similarly, the tooth-profiles of any plane section AA must be such as to gear correctly with a rack *aaaa*, fig. 3. The plane whose [illegible] is XX must also remain at a constant distance from the axis of rotation. According to this view any section of a worm-wheel by a plane perpendicular to its axis is the conjugate of a rack whose profile is the section of the mating worm in the same plane. In other words, the profiles of the worm-wheel teeth are the evelopes of all the possible successive positions of the worm teeth which the latter can assume when working in proper relation to the former.

SOME ILLUSTRATIONS.

In fig. 5 (page 178) the statement just enunciated is illustrated, several successive positions of the central section—that is, the section in the plane BB of fig. 1—of the worm are shown in proper relation to the worm-wheel.

The profile of the worm-wheel is seen to be the envelope of the various outlines of the section of the worm-thread. The outline of the worm-thread, in moving from the position *qqqq* to *pppp*, sweeps out the profile *wwww*, which represents a boundary within which it cannot enter, but every part of which it is forced at some time to touch. The central section of the worm yields a symmetrical profile *bbbb*, fig. 2 (page 178), and the conjugate section of the worm-wheel is also symmetrical, fig. 5 (page 3). All other sections of the worm by planes, such as AA, or CC, parallel to BB, yield unsymmetrical profiles, and the conjugate worm-wheel profiles are also unsymmetrical.

Thus in fig. 6, *rrrr* represents a section of the worm-thread by the plane AA, fig. 3, in one of its proper positions relatively to the worm-wheel whose pitch line is YY; *ssss* also represents the same worm-thread in another possible position, and sufficient intermediate positions of the profile have been drawn to show the unsymmetrical profiles of the worm-wheel teeth, which, as stated before, are merely the envelopes of the successive positions assumed by the section *aaaa*, fig. 3, of the worm-tooth.

Fig. 7 (page 178) represents a section of the worm-wheel by the plane CC situated on the side of BB opposite to AA and at the same distance from it. It should be noticed that the sections *aaa*, *ccc*, in figs. 3 and 4, are sections of the worm-threads by planes symmetrically situated with reference to the central plane BB, and that either may be regarded as the obverse of the other. That is to say, *ccc*, fig. 4, presents the same appearance to an observer in front of the plane of the diagram as *aaa*, fig. 3, presents to an observer situated at the back of the plane of the diagram. In the same way the section *yyyy*, fig. 7, which is the conjugate or envelope of the successive positions of *ccc*, fig. 4, is merely the obverse of the section *www*, fig. 6, which is the conjugate of *aaa*, fig. 3. Regarded in this way, the whole surface of the worm-wheel is realisable, for it is clear that the positions of the planes AA, BB, in fig. 1, have been selected in a perfectly general manner. It should be noticed that, as the plane of section is removed farther away from the central section, there is an increasing tendency of the worm-thread to become skewed or distorted, leading to a similar tendency on the part of the conjugate profile of the worm-wheel teeth. The effects of increasing the pitch, or decreasing the pitch diameter of the worm, are precisely similar, skewing or distortion being in each case increased. These statements will become clear on studying figs. 8 to 10b (page 179).

Fig. 8 represents a quadrant of the transverse section of a worm. BB is the trace of a plane containing the axis, and DD and EE are the traces of planes parallel to BB.

In fig. 9 the shaded profile *dd* represents the section of the worm by the plane DD, *bb* being the section by the central plane.

In figs. 9*a* and 9*b* the effect of doubling and then trebling the pitch is clearly shown, the tendency to "skew" being very marked as the pitch is increased.

In figs. 10, 10a, and 10b, sections in the plane EE of fig. 8 are exhibited in conjunction with the central section, and the effects of departure from the central

DOUBLE-THREADED R H WORM, 4" pitch, 4" outside diam, 3" pitch diam

FIG 1.—*Transverse Section.*

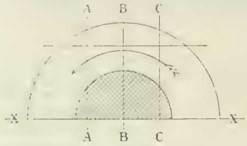


FIG. 2.—*Section on BB*
(As seen from left of BB in Fig. 1.)

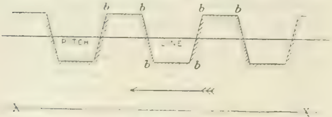


FIG. 3.—*Section on AA*
(As seen from left of AA in Fig. 1.)

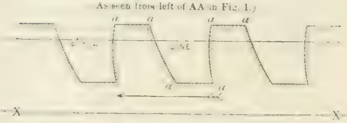


FIG. 4.—*Section on CC*
(As seen from left of CC in Fig. 1. "Obverse" of *aaa* in Fig. 3.)

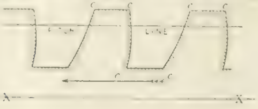


FIG 5.—*Generation of the central profile of Worm-Wheel Teeth*

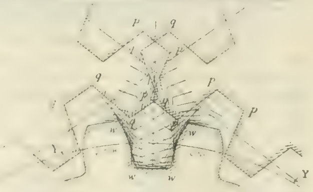


FIG. 6.—*Generation of Worm Teeth profiles in plane* AA (FIG. 3)

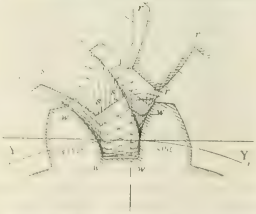
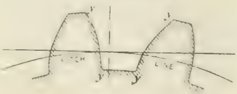


FIG. 7.—*Section of Worm-Wheel in plane* CC (FIG. 4)
("Obverse" of *www* in Fig. 6.)



[illegible]

Fig. [illegible] the pitch diameter of fig. 8, the pitch and the form of thread remaining unchanged. Fig. 13 compares in all respects except pitch diameter with fig. 9b, the pitch and distance of the plane of section from the central plane being identical. The effect of increasing the diameter is to very much regularise the profile of the sections in planes parallel to the central plane.

Fig. 13 may be compared with fig. 10b and the effect of increasing the diameter is seen to be equally marked in the case of sections by the plane EE. These illustrations will serve to explain the general tendency of the forms assumed by correctly shaped worm-wheels. Valuable as it is that correct notions on these points should be current, they are not of immediate practical importance.

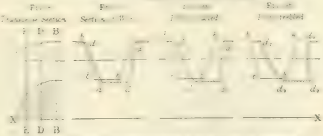
Though accurate machine methods of producing worm-wheels have been known for at least seventy years (Sir J. Whitworth patented his hobbing machine in 1835), nearly all worm-wheels in common use till within late years were cast from wooden patterns. The production of the pattern was seldom dependent upon the previous accurate determination in the drawing office of the correct profiles of its various sections. However produced, a correct knowledge of the forms of the teeth is necessary rather for the comprehension of the finished article than for its production.

NATURE AND EXTENT OF CONTACT.

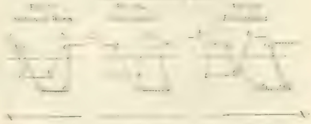
[illegible] Given a perfectly formed worm-wheel and its mating worm, what is the nature and extent of the contact that takes place, and how are these affected by the proportions assumed? It is evident that a knowledge on these points must be gained before a really satisfactory basis for determining the proportions of worm gearing for a given load or duty is arrived at, and until some satisfactory theory is developed purely empirical methods must be used.

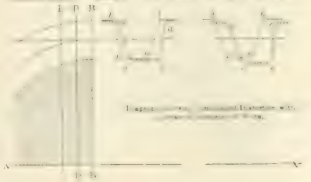
In developing the theory which follows, the method of procedure is to examine what takes place in various planes parallel to the central plane of the worm-wheel. And, as has been already pointed out, the action of the sections of the worm and worm-wheel by such a plane is precisely analogous to gearing together a rack [illegible] point of contact of the tooth-profiles must pass through the pitch point or point of contact of the pitch lines. This is the fundamental condition which must be obeyed by any profiles whatever which are suitable for correct gear teeth. This statement needs no formal proof, for at any moment the correct motion of the pitch surface of the wheel relatively to the rack or that of the rack relatively to the wheel is one of rotation about the pitch point as virtual centre; any other disposition of the surfaces of the teeth in contact than that stated, would therefore lead either to their separation or interpenetration. Thus in fig. 14 (page 180) the pitch line of the rack is *p*R; that of the wheel being *p*W, which touches *p*R at the pitch point *p*; *rr* is one position of a rack or worm-tooth. The point at which contact takes place can now be readily determined, for, if a normal *pa* be drawn from *p* to *rr a* is the only point which fulfils the condition laid down. WW, the profile of the wheel-tooth, must also touch *rr* at *a*, and *pa* must be normal to it. On this condition alone is rotation about the instantaneous centre *p* possible. As a rack tooth passes through all its stages of contact with an engaging tooth, the position of the point of contact is continually changing, and relatively to the pitch lines its path is determinable and is termed the path of contact.

[illegible]



[illegible]





The path of contact for any particular rack tooth can be readily found as follows:—$r\ r$ is the profile of the driving side of a rack tooth, and $p_1 p_8$ is the pitch line, fig. 15 (page 180), normals $p_1 r_1$, $p_2 r_2$ . . . $p_8 r_8$, are drawn at intervals to cut the pitch line at p_1, p_2 . . . p_8). When contact takes place at r_1, p_1, must coincide with the pitch point; similarly when contact is at r_2, p_2 coincides with the pitch point. If therefore, as in fig. 15a, the normals and the profiles are redrawn in the successive positions, when contact takes place at r_1, r_2 . . . r_8, a series of points on the contact path will be obtained, and a fair curve through these gives the contact path r_1 . . . r_8, fig. 15a. The shape of the contact path depends solely upon the shape of the rack tooth. Thus in fig. 15a a rack tooth convex with regard to the mating tooth has a curved contact path concave towards the centre of the mating gear. If, however, a rack tooth is concave on the side of the mating tooth, the path of contact is curved so as to be convex towards the centre of the mating gear, as in figs. 16 and 16a (page 180), whilst a straight line rack tooth has a straight line path of contact. The curvature of the contact path is greater or less according as the curvature of the profile of the rack tooth is greater or less, and its inclination to the pitch line is also greater or less according as the inclination of the rack tooth profile is greater or less.

LIMITATION OF PATHS OF CONTACT.

The limitations of the paths of contact are determined in general by its intersections with the paths of the extremities of the mating tooth-profiles. Contact commences at the intersection of the contact path with the circle limiting the worm-wheel teeth, and ends at its intersection with the straight line through the tips of the worm-teeth. In certain cases, however, the path of true contact is considerably abridged by reason of interference. In order that the path of contact may be determinable for any plane section selected, it is necessary to know when interference is likely to occur, and for this purpose it is necessary to study in greater detail the method of obtaining the conjugate of any given rack or worm profile.

In fig. 14 (page 180) the line ap, which is a normal of the rack tooth, is also a normal of the wheel-tooth at the point of contact, and the same holds good for any other point of contact.

In figs. 17a (page 180) $p_1 r_1$, $p_2 r_2$, etc., are normals of the rack profile, $r_1\ r_{11}$, when r_1, r_2, etc., are points of contact, and p_1, p_2, etc., coincide with the pitch point P. Hence if WP is the pitch line of the wheel-gearing with the rack whose profile is $r_1\ r_{11}$, points w_1, w_2, etc., can be obtained on the conjugate profile which will come into contact with the points r_1, r_2 etc., of the rack profile as follows:—

Make the arc p_1, P, fig. 17b, equal to the line p_1 P, fig. 17a, and draw $p_1\ w_1$ equal to $p_1\ r_1$, and inclined to the radius p_1 O at an angle equal to O$p_1 r_1$ in fig. 17a. Find p_2 and w_2, etc., in a similar manner.

FIG. 14.—*Illustration of Fundamental Condition of Contact of Profiles.*

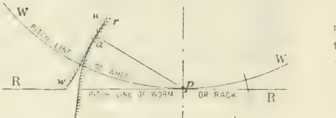


FIG. 15.
Convex Profile.

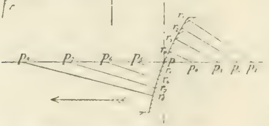


FIG. 15a.—*Contact Path for Convex Profile.*

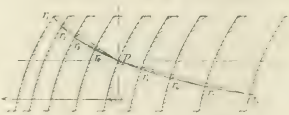


FIG. 16.—*Concave Profile.*

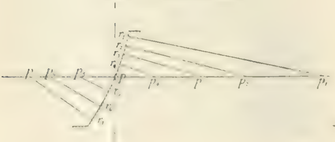


FIG. 16a.—*Contact Path for Concave Profile.*

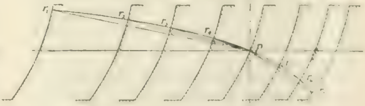


Fig. 17a.
Limitations of Contact.

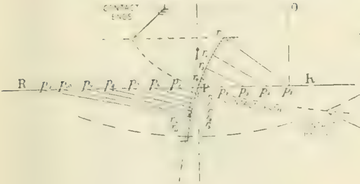


Fig. 17b.
Construction of Conjugate Profile.

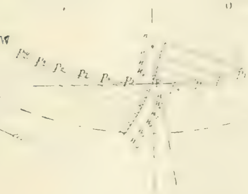


Fig. 18a.
Limitation of Contact due to Interference.

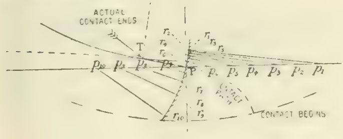
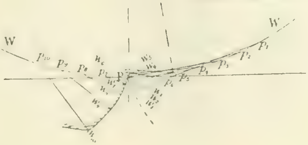


Fig. 18b
Construction of Conjugate.
(w_1–w_5 is "imaginary.")



SOME LIMITATIONS ILLUSTRATED.

It is obvious that if P in figs. 17a and 17b were brought into coincidence and the pitch lines were brought into their proper relative positions so that p_1, p_2, etc., successively coincided at P, then w_1 would coincide with r_1 and w_2 [illegible] with r_2 [illegible] also in its turn [illegible] would coincide with [illegible] and [illegible] with [illegible] so that w_1 is one point, and w_2, w_3, etc., other points of the conjugate profile. This method of using the normals to construct the conjugate of the rack profile is therefore an alternative to the method of envelopes already described. It is evident in fig. 17a that as the lower part of the convex profile is approached, the normals greatly extend in length, and if they are drawn for portions below r_{11}, the direction of the normal will ultimately be parallel to the pitch line, and hence will never meet it. It will now be impossible to find any point on the conjugate profile which will come in contact with a point in the profile from which a normal parallel to the pitch lines is drawn. When, therefore, the path of contact becomes parallel to the pitch line of the rack, further contact becomes impossible.

A limitation in the other direction is illustrated in figs. 18a and 18b. The rack profile is here concave and the path of contact is such that a circle concentric with the pitch circle touches it at T. Contact beyond the point T cannot take place. For if the construction already described be applied in fig. 18b to find the conjugate profile, we find that the resulting curve has a cusp and that the second branch of the curve w_5 w_1, corresponding with that portion of the contact path beyond T, is of such a character that, though the mathematical relationships hold good, physical contact is impossible. If the case be carefully examined it will be seen that contact between the branch w_5 w_1 and the rack r_1 r_5 would take place on the opposite side of r_1 r_5 to that on which contact occurs between the portions w_5 w_{10} and r_5 r_{10}. The actual contact path therefore is liable to limitations in two ways: (1) through interference, and (2) through the limitations the mating teeth themselves. When contact ends through interference, the points at which contact vanishes are those at which the contact path coincides in the direction with the motion of either of the moving members, that is, where the contact path becomes parallel to the straight pitch line or is touched by a circle concentric with the circular one. In the second case, as already stated, contact ceases at the points of intersection of the contact path and the paths of the extremities of the tooth surfaces. By the method described above, the contact path for any section of a worm parallel to the middle plane can be found.

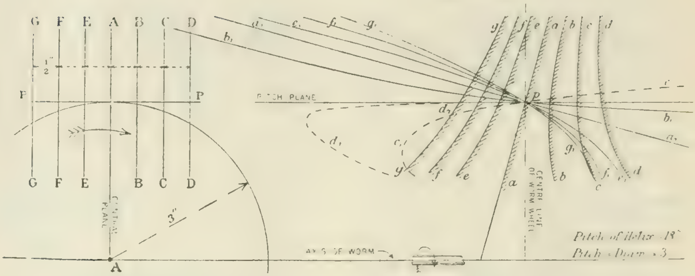
Figs 19 to 20a.

Plane Sections of Contact Surface for various ratios of Pitch to Diameter.

Transverse Sections

Longitudinal Sections

Fig. 19.



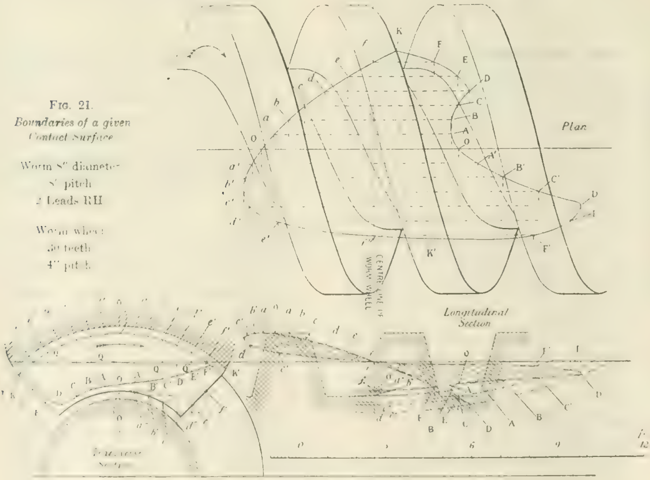


Fig. 21.

Boundaries of a given Contact Surface

Worm 8" diameter

8" pitch

2 Leads RH

Worm wheel

30 teeth

4" pitch

In fig. 19 (page 182) the lines of contact are drawn for a worm whose acting face is generated by the line *aa*, which rotates and advances along the axis at the rate of 18 in. for one complete turn. The pitch plane is situated 3 in. from the axis and the inclination of *aa* to the axis is 15 deg. The surface generated therefore is that of a right-hand worm whose pitch is three times the pitch diameter. The lines *bb*, *cc*, *dd*, *ee*, *ff*, and *gg* are sections of the worm surface by planes whose traces are AA, BB, CC, DD, EE, FF, and GG, in the transverse section. The corresponding lines of contact are a_1a_1, b_1b_1, [illegible] e_1e_1, f_1f_1 and g_1g_1, which are the sections of the surface of contact by the planes of section AA, BB, etc. The surface is seen to be twisted. All sections of the contact surface cut the line PP whose trace in the longitudinal section is *p*. It will be seen that there are no real lines of contact corresponding to sections of the worm surface *cc* and *dd* by planes CC and DD. The dotted line d_1d_1 and c_1c_1 represent imaginary contact lines fulfilling the mathematical conditions of contact only, physical contact being prevented by interference. There are real contact paths beyond the regions of the diagram corresponding to the sections *dd* and *cc*, but they are at such a distance to the left of the diagram that in conditions likely to arise in practice they may be ignored.

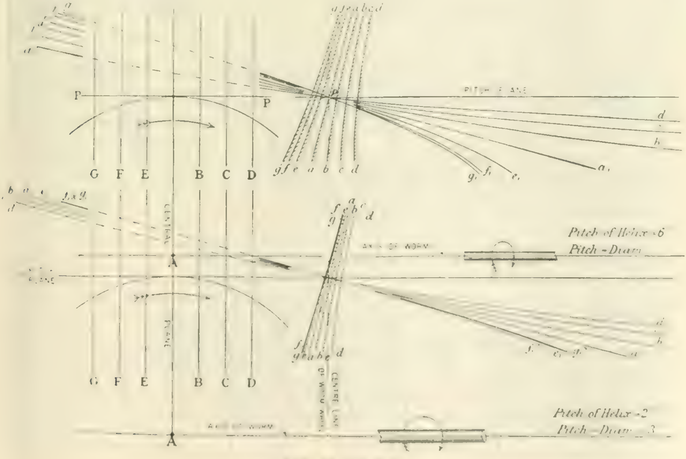
CONTACT SURFACES OF STEEP-PITCHED WORMS.

The contact surface of the fig. 19 is typical of the contact surfaces common to all very "steep-pitched" worms where the helical angle at the pitch line approaches 45 deg. (the angle in this case being 43 deg.—50 deg). Certain peculiarities should be noticed.

Fig. 20a represents the sections of profiles and contact surface of a worm of the same diameter, the pitch being reduced to 2 in. and the helical angle being 6 deg. 4 min.

In conjunction with the foregoing remarks, figs. 19, 20, and 20a sufficiently indicate the general tendency of the surface of contact for any given worm.

Fig. 21 (page 182) is drawn to scale to illustrate the actual boundaries of the contact surface in the case of right-hand worm 8 in. diameter, 8 in. pitch (double thread), gearing with a worm-wheel with 30 teeth. The lettering is similar in all three views of the contact surface, the boundary of which is KOK1O—the dotted lines *a* A, a^1 A^1, etc., represent lines of contact in planes parallel with the central plane (that is, dividing the worm-wheel symmetrically and containing the axis of the worm).



FIGS. 20 AND 20A.

INFLUENCE OF CURVATURE OF PROFILE.

The influence of the curvature of profiles in contact is illustrated in figs. 22 and 23 (page 184) which represent various positions of the profiles of the worm and wheel of fig. 21 (page 182), the planes of section being symmetrically chosen with reference to the central plane. The contact along dD in fig. 22, though much less extended than that along d^1D^1 in fig. 23, is of a kind much more adapted to withstand heavy pressures, the convex profile of the worm-wheel fitting into the concave profile of the worm in fig. 22, whereas in fig. 23 the opposite curvatures of the profile are less suited for retaining the oil-film upon which the power of sustaining a load depends. Generally speaking, on the side of the central plane where the worm is advancing the curvature of the profiles is alike though the path of contact is less extended, whilst on the side of the central plane where the worm is receding the contact path is more extended and the curvature of the profiles is unlike. It follows, therefore, that the mere extension of the contact surface of a worm and worm-wheel is insufficient in itself to determine the amount of end pressure which can be safely sustained at any given speed, the curvatures of the various sections of the surfaces in contact playing an important part. The ability of any given worm-gear to withstand wear depends upon the maintenance of an oil or grease-film between the surfaces in contact. As the tooth of a worm-wheel passes through all the phases of its contact with the worm-thread, the line of contact traverses across its face, and is therefore continually passing across portions of the worm which, since being in contact with the preceding worm-wheel tooth, should in a well-lubricated system, have been freshly lubricated.

A FACTOR OF PRIME IMPORTANCE.

The rate of transference of the line of contact over the tooth face in conjunction with the tangential rubbing velocity is therefore a factor of prime importance. The width of the contact line or its dimensions across the face of the teeth and its effective breadth are factors of equal importance. By "effective breadth" the dimension parallel to planes of section is meant, see fig. 24 (page 184). The "effective breadth" is indeterminable, but a comparative estimate can be formed of it by considering the curvature of the surfaces at any section. Thus, in fig. 24 (page 184), it is obvious that a much greater load would be sustained by a surface such as is illustrated at *a* than by surfaces such as *b*.

Abstract of paper read before the Institution of Mechanical Engineers

(*To be continued*

FIG. 22.—Sections of worm and worm-wheel Teeth in contact by plane d D *on advancing side of worm*

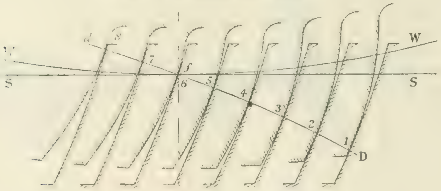


FIG. 24 —*Influence of Curvature on Effective Breadth of Contact Film.*

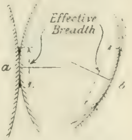
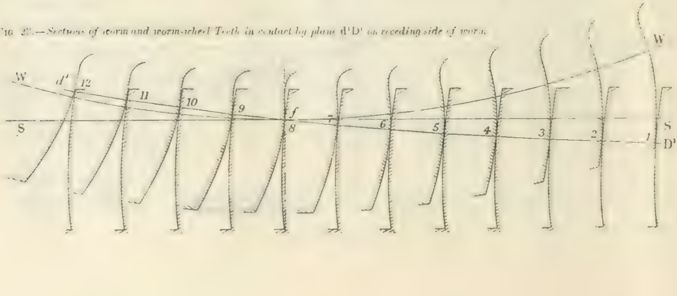


FIG. 23.—*Sections of worm and worm-wheel Teeth in contact by plane* d'D' *on receding side of worm.*



THE FUTURE OF OUR CANALS.

(*Continued from page 126.*)

THE FOXTON LIFT

THE lower portions of the inclined planes, described in the previous article on the Foxton lift, descend below the level of the water in the tail bay, which is an unimpeded continuation of the lower canal (hoisting gates not being necessary), so that the docks, with or without floating vessels, run down into the water, and so establish a connection, both as regards level and alignment, with the water in the lower-level canal, so as to allow of vessels being hauled either in or out of either of the docks.

The two inclined planes are placed side by side, and although at the same inclination and extending between the same levels they are not in the same plane, but escheloned, so that the one extends from the right side of the head bay to the right side of the tail bay, whilst the other extends from the left side of the head bay to the left side of the tail bay.

In order to compensate for the alteration of the balance between the ascending and the descending docks consequent on the immersion of the descending dock in the lower pond, the normal gradient of the railways at the upper ends of the inclines is gradually diminished so as to avoid the necessity of providing for the great variation of the haulage power which would otherwise be necessary in order to overcome the unbalanced weight of the ascending dock when the descending dock is immersed in water.

So that the dock shall preserve its horizontality (*i.e.*, shall preserve its normal position relatively to the surface plane of the contained water) whilst travelling on the part of the incline of which the gradient is gradually varied, each of the carriages upon which the dock is supported is provided at the side towards the top of the incline with duplicate sets of wheels, the wheels of the two sets being in different vertical planes, and at the upper part of the incline different sets of rails are provided for each set of wheels, these duplicate set of rails gradually deviating to equal extents from the normal plane of the incline, the deviation of the two sets of rails being, however, at such different points in the length of the incline that the parts of the incline on which the leading and trailing wheels of the carriage may be situated at the same moment during any part of their travel are always of equal gradient and at equal degrees of deviation from the normal gradient.

The profile of the upper part of the incline of gradually varying gradient is therefore a pair of similar curves for the two sets of rails, and this curve of equilibrium and the extent of deviation from the normal gradient are ascertained by a calculation of the diminution of the hauling effort of the descending lift from its point of contact with the water to the point of complete immersion in the bottom pond, taking into account the gradient of the incline, the weight and specific gravity of the lift and its contents, the friction and all other of the varying circumstances of each particular case.

The two docks are connected by a balance rope acting independently, and two hauling ropes to each dock are provided, passing around a winding drum in opposite directions, so that the two ropes attached to the dock to be raised are hauled in whilst the two ropes attached to the dock to be lowered are payed out; motion to the drum is imparted by a worm wheel attached to the drum, and is actuated by engine power. The quantity of water raised on the average equals that lowered between the two levels so that there is practically no loss of water, and as the vessels transported by the lifts are water-borne the weight of the load carried by the dock is always the same, whether the vessel be loaded or not, and whether the dock contains a vessel or not. Very slight investigation will reveal the fact that this system possesses great advantages over the old method of locking.

THE PLANT DESCRIBED.

The photographs given last week showed the works which have been carried out by the Grand Junction Canal Company: the difference of level between the upper and lower canals being 75 ft. 2 in.

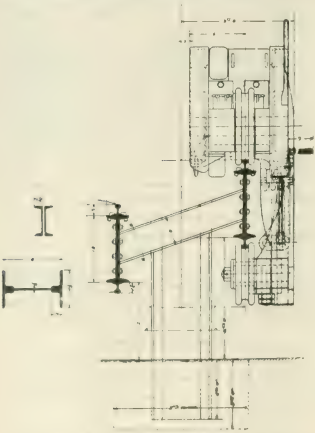
The plant consists of two fixed conduits and two movable docks, together with the necessary hydraulic gates and rams, steam engine and boilers, hydraulic pumps, accumulator, steel wire ropes, hauling drums, guide and deflecting pulleys, etc. The two fixed conduits form the ends to the upper canal and support the necessary gates and face fits. The two movable docks are built of steel plates, each dock being mounted upon eight sets of wheels, running on four pairs of rails laid upon an inclined plane, the grade of which is one in four. Each dock is 80 ft. by 15 ft. 5 ins., inside, and is capable of accommodating two 33 ton canal boats, or one barge carrying 70 tons.

The movable docks are connected by 7-in. steel wire ropes passing round the guide pulleys and hauling drums; consequently when one dock ascends the other descends, thus balancing each other, the engine simply having to overcome the friction of the moving parts.

The engine for driving the main hauling drums working the plant is of the double cylinder high-pressure jet-condensing type, the power being transmitted to the drums by means of powerful worm gearing. The boilers are of the Lancashire type, two in number, one, however, being of ample power to do the work, the other being simply held in reserve.

THE SAVING IN TIME AND COST OF WORKING.

The hydraulic pressure is obtained from a horizontal duplex pump, having outside bucket plungers. This [illegible] [illegible] accumulator, which is sufficiently large to hold a reserve of water to work all necessary cylinders simultaneously. In order to save manual labour, the gates of the docks and conduits are raised and lowered by hydraulic power.



SECTION OF HAULAGE TRACK AND ELECTRIC TRACTOR FOR ERIE CANAL.

When a boat has to be raised it is floated into whichever dock is at the lower level, through a suitable gate at the end, the water in the dock being, of course, at the same level as that in the canal; the gate is then closed by means of hydraulic cylinders, and the dock is hauled up the incline with the boats still floating. Thus the boats are water-borne during the whole operation, and are not in any way strained.

Upon arriving at the top of the inclined plane, the movable dock is held in position against the upper fit by means of hydraulic rams; the gate at the conduit end thereof is then raised simultaneously with the gate of the fixed conduit, thus making connection with the higher canal, immediately after which the boats or barges are at liberty to continue their journey.

The time occupied for the operation of passing two boats in each direction is twelve minutes, as compared with one hour and fifteen minutes, the time taken in passing a single boat, or one hour and twenty minutes for a pair of boats in either direction, *viâ* the existing locks.

The lift is capable of passing from 190 to 200 ordinary canal boats in 12 hours of continuous working, and the whole plant can be worked by three men.

The total cost of the works (inclusive of plant, machinery, and land) together with the expenditure due to forming the upper and lower connecting canals, which extend for a distance of about a half-mile and comprise on the upper level a high embankment and on the lower level a cutting of considerable depth, together with bridges, protecting walls and works has amounted to the sum of nearly £40,000.

With regard to the cost of working, the duty, taking fifteen minutes intervals between the operations, is 6,000 tons per day of 12 hours, and the cost of dealing with this tonnage, based on the actual experience of the past twelve months, is about £1 4s. 6d. per day, including coal, oil, stores, and labour; which is equivalent to about one-twentieth part of a penny per ton.

LEEDS AND LIVERPOOL CANAL.

This canal serves the populous manufacturing districts between Liverpool and Leeds, serving the towns of Wigan, Blackburn, Skipton, Keighley, and Bradford. The stretch of canal from Liverpool to Blackburn, fifty-seven miles, has during recent years been much improved both in cross section and depth, and further improvements are now in contemplation.

NEW MAIN ROUTES AND THEIR COST.

Some of the proposed main canal routes were shown in section last week, and, as intimated in a previous article, they would prove of immense value to commerce. It is probably quite safe to say that in comparison with railways rates could be reduced in every instance by 40 per cent., often by 50 per cent., and in some instances the saving on carriage would represent an even greater percentage. The probable cost of improving our main waterways to enable barges of

250 tons capacity to navigate them, as stated in a previous issue, has been estimated at £10,000,000, but we regard this as a conservative figure. This is reckoned on the assumption of making about 250 miles of new canal and widening and improving 200 miles of existing canal at a cost of £30,000 per mile in the former case, and £15,000 in the latter. It may be pointed out that this is considerably less than the sum spent on the construction of the Manchester Ship Canal alone.

METHODS OF HAULAGE.

Side by side with the improvements on the canals, there would have to be a revision of the modes of canal haulage in common use. At the present time the work is mainly done by horse-towing. However, it is only fair to admit that the canal authorities are alive to requirements in this respect. On some of the well-managed waterways to which reference has been made steam towing is largely employed, and an experiment is now being made with a boat which has been fitted by Messrs. Thornycroft with a suction gas engine plant. The boat in question, the "Duchess," of which an illustration appeared on Jan. 12, has now completed the main part of the programme given below. The conclusions arrived at from the first stage which included 130 locks, and a total distance of 135½ miles, are highly favourable to the suction gas plant and its application to the canal barge. The few alterations or improvements necessary include a different type of propeller and a charging hopper or producer, to avoid any delay in refuelling. The engine first fitted was a two-cylinder of 35 h.p., and it is stated that a reduction in the power of the engine from 25 to 16, or even 12 h.p., would produce equally useful results. The total fuel consumption for the 135½ miles amounted to 18 cwt. The tour comprised the following stages :—

Birmingham to Ellesmere Port, *via* Wolverhampton, Autherley, Market Drayton, Nantwich, Chester, and Ellesmere Port.

Ellesmere Port to Manchester, *via* Manchester Ship Canal, or Bridgewater Ship Canal.

Manchester to Preston Brook, *via* Bridgewater Canal.

Preston Brook to Middlewich, *viâ* Stoke-on-Trent, Stone, and Fradley.

Fradley to Fazeley, *viâ* Tamworth, Atherston, Nuneaton, and Hawkesbury.

Hawkesbury to Rugby, *viâ* Banbury and Oxford, and to London by the Thames.

Many are of opinion that there is a great future for the internal combustion engine in connection with canal haulage. With producer gas in Germany the expenses are stated to have been about ⅛d. per ton mile.

ELECTRIC HAULAGE.

On the applicability of electrical power to the needs of inland waterways opinion differs somewhat widely. Development in this direction has been along two main lines—haulage by electric tractors running on a railway parallel with the canal, and towage by tug fitted with storage batteries. A third proposal somewhat revolutionary in character suggests the draining of the canals and converting them into electric railways. The first of these proposals, in spite of the fact that it implies maintaining a railway as well as the waterway, has been put into practical operation. The device in question was described by Mr. Léon Gerard and Mr. St. Johns Clark in a paper recently read before the International Congress of Navigation at Milan. In the earlier experiments on the Erie Canal, it was found that the weight of the electric tractor could not with economy be made sufficient to give the desired speed to the barges.

HAULAGE ON THE ERIE CANAL.

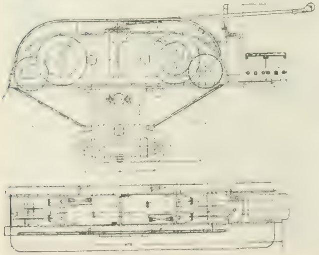
An improvement was made by the introduction of powerful springs, which exercised a gripping effect on the under rail.

PROPORTIONAL ADHERENCE TRACTOR.

A difficulty with this method was the low efficiency with high traction strains, which fell to 45 per cent., with strains of 220 lb. Within the past year a new type of tractor, the "proportional adherence tractor," has been employed on a special track at Schenectady. The driving wheels, which are 12 in. diameter, work on the upper part of the guide girder. The greater portion of the tractive effort at the moment of starting is supplied by wheels which run under the guide girder. The pressure exerted by them comes into play only when the tractive strain comes on to the tow rope. The two springs, placed under the pressing wheels, are so adjusted as to obtain a contact with the guide girder without undue pressure.

Although this apparatus weighs only three tons, it is capable of exerting a pull of one ton at a speed of 4½ miles per hour, under which condition the overall efficiency is 86 per cent. The tractor is equipped with a 45 h.p. motor of the mine type, of compact iron-clad construction, the centre of gravity of which rests under the guide girder.

The track consists of girders held in place by vertical posts of lattice construction, to which they are fastened through brackets. A single track weighs 60 tons per kilometre, and a double track weighs 105 tons per kilometre. The track proper is formed of 10-in. girders with large flanges, and weighs 80 lb. per yard. It presents a projecting guide on the top and bottom flanges. A track of this construction lends itself most favourably to electric traction for canals, the haulage path of which is narrow and it is well adapted to overcoming the difficulties due to crossings and bridges, and those found in tunnels of reduced sections.



ELEVATION AND PLAN ELECTRIC TRACTOR

100 H.P. USED ON ERIE CANAL.

With no load and at the greatest speed, the apparatus does not exert on the track any pressure other than that due to its weight of 64,000 lb. At a speed of eight miles per hour without load the tractor motor absorbs 7 k.w.

It is estimated that the net efficiency is 84·5 per cent. It is believed that the "proportional adherence tractor" can improve the efficiency of electric canal haulage, increase its speed and render it thoroughly practicable. While many forms of mechanical and electrical traction have been devised and even utilised, the drawback of the majority of such systems has been the excessive weight of the tractor and its track, in order to obtain the necessary adhesion.

On the question of towage by tugs fitted with storage batteries, it is enough to say that a battery for such a purpose has yet to be evolved.

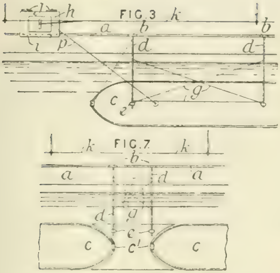
CONVERTING CANALS INTO ELECTRIC RAILWAYS.

On this subject Mr. F. F. Bennett has recently written at some length.

Mr. Bennett's scheme is practically to convert the canal routes into electrically-operated goods railways, and where possible to cater for the local short-distance tramway class of passenger by running tramcars at stated intervals. He dispenses with the ordinary railway station, and with signalling as applied to railways, his working conditions approximating to those on a tramway. Some 800 miles of canal route are selected for conversion in the scheme drawn up, with a capital of nearly £9,000,000 sterling. Where these touch tramway routes, they are to be suitably connected.

The great feature claimed is the connection of the large towns of Lancashire, Yorkshire, Staffordshire and Warwickshire with London and the intervening districts. To carry out this scheme would call for 43 miles only of additional lines. This provided, the system would serve 30 towns of over 50,000 inhabitants, with a population within eight miles of either bank of over 13,000,000 or nearly 16,000 per mile, a population greater than is found along any railway in England. The North-Western stands first at 10,000 per mile; the average for England and Wales is only 2,012.

The cost of conversion per mile is estimated at £5,697 and the total cost of conversion and new construction is put at nearly £5,000,000. Goods and passengers, at 2s. 6d. per ton and ¾d. per passenger mile respectively, are to bring in a revenue of nearly



SHOWING DETAILS OF LATEST HAULAGE SCHEME.

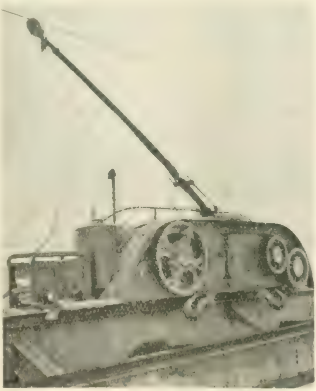
£4,000,000, on a basis of the average traffic of five of the chief railways. Only 200 locomotives are to be allowed in all, to work the goods traffic. Power stations are suggested to be placed at Aylesbury, Nottingham, Birmingham, Leeds and Wigan, and the electrical equipment, including the 200 goods tractors and 504 passenger bogies, is to absorb something over £7,000,000 sterling. The proposal appears on the surface to be rather more fanciful than practical and is not likely to be seriously entertained.

A recent invention in the field of canal haulage by Messrs. Dixon, of Southampton, is illustrated above. It comprises a groove or rail on the canal bank, which works a guide-roller attached to an arm on the vessel. In the first arrangement illustrated the booms *d*, secured to the posts *c* on the vessel C, carry wheels *i* working in [illegible] the [illegible] rail [illegible] the towing-path. The connection between the arm and wheel is such as to enable universal movement. The booms *d* are stayed by guys *j*, and may be adjustable in length. We also show a modified plan, the booms *d* being mounted on separate pontoons C¹, which are placed between the barges. The groove or rail *a* is used to guide an electric or other locomotive *h*, the wheels *i* on one side of the locomotive working on or in the rail *a*. The wheels *j* on the other side may be either of the ordinary road-traction or flanged railway type. A trolley wire *k* may be supported over the towing-path in the usual manner. The vessels C are attached to the locomotive by a rope *p*.

No reference to canal haulage problems would be complete without a reference to the Thwaite-Cawley system first proposed in 1894. The method consists in the employment of an electric horse, as the motor is called, that travels on light superposed steel rails carried by vertical standards erected at intervals along the extreme boundary of the canal tow path. The wheels of this electric horse grip on the steel rail providing the adhesion necessary to secure the haulage of the boat, the grip of the motor being directly proportionate to the tension on the tow-rope. One rail permits the electric horse to draw its boat in one direction, and another, super-elevated, permits its electric horse and without risk of entanglement of the two ropes, to draw its burden in the contrary direction.

HAMBURG PORT IMPROVEMENTS.

During the years 1897-1900, 8,600,000 marks were spent upon the deepening of the Elbe between Hamburg and Altona, and in 1902 the city entered into a contract with Prussia, according to which the former undertook to secure and maintain until the end of 1905 a uniform depth of 10 metres (5 fathoms) in the fairway from Hamburg as far as the Lüher Sands. This has now been accomplished at an additional cost of 6,500,000 marks, making a round total of 15,000,000 marks. As a result, vessels drawing 30 ft. of water can now reach Hamburg without previously discharging a portion of their cargo.



VIEW OF THE CANAL TRACTOR IN POSITION NEAR SIDE.

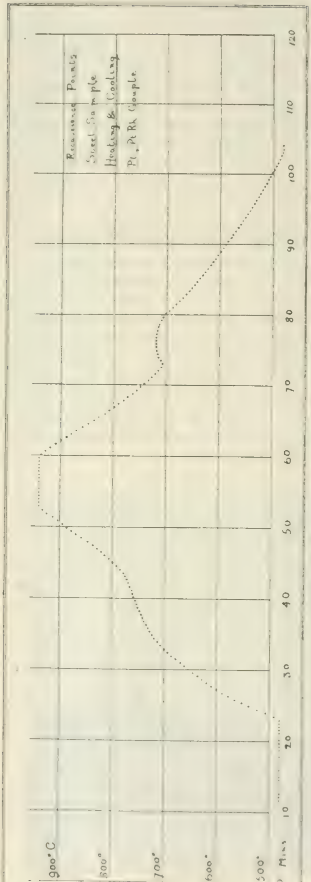


FIG. 2. THREAD RECORDER RECORD.

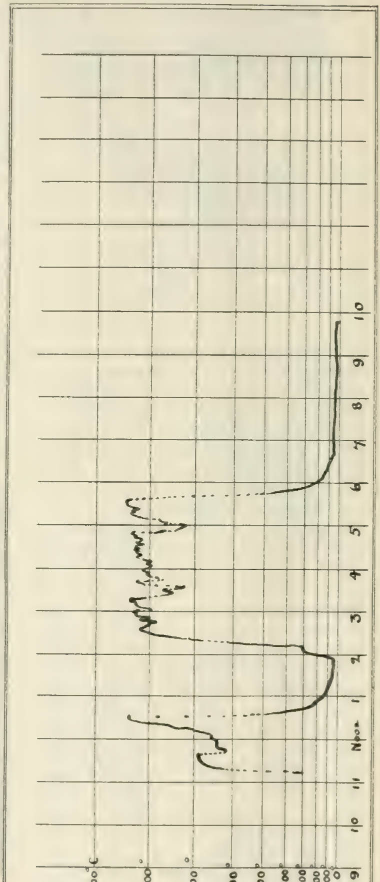


FIG. 3. THREAD RECORDER RECORD. GAS MUFFLE WITH FÉRY RADIATION PYROMETER.

A NEW TEMPERATURE RECORDER.

AT the recent exhibition of apparatus held by the Physical Society of London, at the Royal College of Science, the Cambridge Scientific Instrument Company, Ltd., exhibited a new form of recorder. The instrument was employed to record the temperature of a steel sample, by means of a thermo couple, and the temperature range chosen for the record enabled the recalescence point of the steel to be shown as the sample was heated and cooled.

The instrument is essentially a delicate recording galvanometer, so arranged as to give a series of records of the instantaneous deflections of a galvanometer boom. The method employed for producing these records has the advantage of producing continuously visible records, while avoiding pen-friction. Fig. 1 is a diagram showing the essential parts of the recorder. A is a galvanometer boom turning about its axis B, and overhanging a drum C. Between the boom A and the drum C an inked thread is stretched parallel to the axis of the drum, and at a short distance above its surface. A presser-bar D is situated above the galvanometer boom, and this bar is normally held free of the boom by means of a cam E, and its follower F. At regular intervals the cam E makes a half-revolution, allowing the presser-bar D to fall upon the boom A and then raising it again to its normal height. As the presser-bar falls, it depresses the boom on to the drum, nipping the inked thread between the boom and the paper. The boom end has a knife-edge on its under side, which produces a dot upon the paper at the point of the intersection of the boom, and the thread, thus making a visible record of the instantaneous deflection of the galvanometer. The galvanometer boom is hinged so that it can be depressed without bending the suspension. In the intervals between the production of the dots the galvanometer is, of course, free to take up its true deflection without frictional errors. As the dot is always produced where the thread and the boom intersect, it will be obvious that, by suitable arrangements of the galvanometer co-efficient paper with rectangular co-ordinates of uniform scale can be used. The drum may be made to rotate once in twenty-four hours, and the instrument can be arranged to make a dot every minute or every half-minute.

By means of a thermo-couple temperature records may be taken of which fig. 2 is an example. For temperatures which are too high, or in situations which are inaccessible for direct thermo-couple work, a radiation method can be used. For this purpose the company supply the Féry Radiation Pyrometer. In this case the "black heat" radiation from the body, whose temperature is to be recorded, is focussed by means of a concave mirror on to a thermo-couple and the E.M.F. thus generated is used to produce the galvanometer deflections in the recorder.

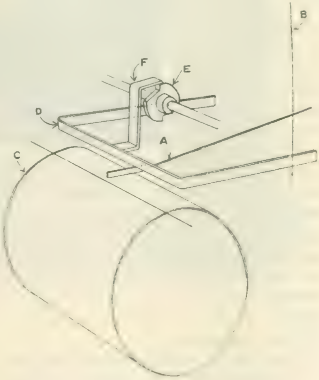


FIG. 1. ESSENTIAL PARTS OF RECORDER.

OUR WEEKLY BIOGRAPHY.

MAURICE WILSON, A.M.Inst.C.E., President of the Society of Engineers.

MR. M. WILSON, who succeeds Mr. Nicholas J. West as president of the Society of Engineers, is the fifth son of the late Joseph William Wilson, M.Inst.C.E. Born at Wandsworth in 1862, he was educated locally at Halbrake School. In 1878 he became a student at the Crystal Palace Engineering School, and passed through the complete two years' course of mechanical and civil engineering; he continued his engineering education in the shops of the Thames Iron Works and Shipbuilding Company, at Blackwall, under the late Richard Hodson, M.Inst.C.E., after which he gained further experience under the late P. W. Britton, M.Inst.C.E., on railway work, etc., and upon the construction of the Midhurst and Chichester branch of the London, Brighton and South Coast Railway, under Mr. J. Phillimore, the resident engineer. He then became an instructor at the engineering school, being in charge at different periods of the pattern shop and foundry, the drawing office, and the civil engineering department.

MAURICE WILSON, A.M.INST., C.E.
President of the Society of Engineers.

In 1885–86 he was connected with Mr. Alex. R. Stenning, A.R.I.B.A., laying out various estates, roads, and drainage schemes, etc. Three years later Mr. Wilson was appointed contractors' engineer upon the construction of the Manchester Ship Canal, which work he left in 1889 to take up an appointment with the London Electric Supply Corporation during the construction of the large power station at Deptford. Later in the same year he returned to the Crystal Palace Engineering School to assist his father, the principal, on whose decease in 1898 he was appointed vice-principal of the school, under his brother, which position he still holds.

Mr. Wilson has been an Associate Member of the Institution of Civil Engineers since 1888, and in December last was elected president of the Society of Engineers for the 1906 session. In the early eighties he gained considerable distinction in the athletic world, and was a well-known member of the Thames Hare and Hounds and of the London Athletic Club. His best performances were across country, and in nine years he ran with the former club a total distance of over 2,500 miles, and won about one hundred prizes. He was an energetic member of the Royal Naval Artillery Volunteers, London Brigade, from 1885 to 1892, when the corps was disbanded.

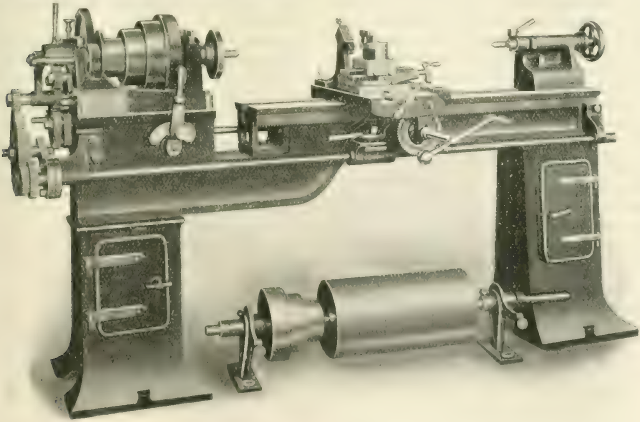
6½-in. CENTRE LATHE FOR HIGH-SPEED STEEL.

BY MESSRS. LECKENBY, BENTON AND CO., HALIFAX.

THE accompanying illustration shows a substantial machine designed by Messrs. Leckenby, Benton and Co. to fulfil the demands of high-speed steel. It will be seen that the various details have been carefully worked out in order to meet the special conditions imposed. The bed is strongly made. The gap has improved filling-in piece which does not spring the bed, and enables a large face plate to be put on spindle nose, without removing gap piece. The fast headstock is of new design, arranged to admit large cone and wheels. The cone has a special oiling arrangement.

The loose headstock has side adjustment by screw for taper turning, and has a bearing between shears of bed, the full length of body. All wheels are machine cut the small pinions being cut from steel blanks. The saddle has quick hand traverse by rack and pinion. The nut gripping leading screw is in two halves, and works horizontally, which prevents the possibility of its dropping into screw when not desired. There is a compound slide rest with swivel arrangements for taper turning. The slide rest is indexed.

The back shaft is arranged so that by means of the lever in front of fast headstock three changes of speed for sliding can be got by simply moving the lever, which can be done while the lathe is in motion. The top driving gear is fitted with three broad pulleys, and has improved oiling arrangements for high-speed running. These pulleys can be used either for reversing or to get another set of speeds.



6½-IN. CENTRE LATHE, DESIGNED FOR USING HIGH SPEED STEEL.

Height of centres, 6 in.; length of bed, 6 ft.; admit between centres, 3 ft. 1 in.; width of bed on face, 9 in.; depth of bed, 6 in. width of speeds, with three speed cone, 2¾ in.; diameter of largest speed, 9 in.; diameter of smallest speed, 5 in.; width of gap, 10 in.; depth of gap, 6 in.; complete weight, 14 cwts.; speed of countershaft, 160 revolutions.

THE MAGNETIC CONCENTRATION OF IRON SANDS FROM THE LOWER ST. LAWRENCE.

NOTES ON SOME RECENT EXPERIMENTS.

BY JOHN F. ROBERTSON, M.SC., S.CAN.SOC.C.E.

IN attempting to use the iron sands from the lower St. Lawrence in a blast furnace three difficulties are met with First, the low percentage of iron on account of the dilution of iron bearing minerals with ordinary sand. Second, the presence of an amount of titanium much greater than that usually considered permissible in an iron ore. Third, the fineness of the material.

The third difficulty can be overcome by briquetting, and may be left to the metallurgist. This note deals only with attempts to cheaply overcome the first and second difficulties. The apparatus used in the experiments described below is of special design based on the Heberli drum separator. It consists of a thin, hollow, brass cylinder about 8 in. in diameter and 6 in. long, revolving loose on a hollow axle, through which wires are passed to a set of eight electro-magnets arranged radially around the axle, and together filling one-half of the drum. The pole pieces just clear the inside of the brass cylinder. Each has a width of ¾ in. to 1¼ in. as desired, perpendicular to the axis, and a length of about 6 in. parallel to it. Each magnet is wound with fifty-five turns of insulated wire, and the wires are led out through the hollow axle to a connection board, so arranged that the magnets can be connected in series, or parallel, and each can be given either north or south polarity. In the experiments described below, the magnets were all in series, with alternate polarity thus: N-S-N-S-N-S. The magnets do not revolve with the cylinder, but may be set to cover any 180 deg. of its circumference desired. The sand is fed to the machine from an adjustable hopper, which can be placed in different positions, so that the feed can be run in at the top or at any part of the side of the revolving cylinder Figs. 1 and 2 show sectional elevations of the cylinder employed in these operations.

The advantage of having the magnets of alternate polarity is that the little grains of iron are turned end for end in passing each magnet. As there are eight magnets, the grains of iron are reversed six or seven times, and, in trying to arrange themselves to suit the magnetism of the various poles, they liberate the grains of sand which might otherwise be entangled in a bunch of grains of iron, and thus be carried over into the finished product.

The apparatus was designed to be run either dry or wet, and the drum can be rotated in either direction and at a great variety of speeds.

In concentrating dry, the sand is fed near the top of the revolving cylinder. The non-magnetic material is collected directly under the edge of the cylinder, while the iron pulled radially by the magnets and moved by the cylinder, passes under the latter and falls off on the other side.

When working with wet sand, the cylinder is rotated in the opposite direction, and the sand fed against the side about half-way down. The sand, with some water from the jet A (fig. 1), reaches the cylinder at B. That part of the cylinder is moving upwards, and the friction of the magnetic material as pulled by the magnets is great enough to carry it with the cylinder against the stream of water from the jet C. The non-magnetic minerals, not being attracted, are washed down and away. D and E are two water jets to clean

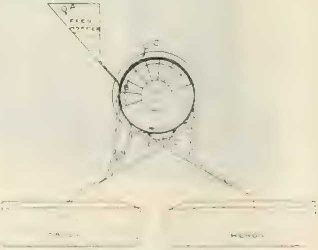


FIG. 1. SEPARATOR AS RUN WET.

[illegible] TiO_2. This works out to a recovery in the cylinder from any materials which tend to adhere beyond the proper points for discharge.

It was found that the co-efficient of friction of magnetite on brass is so low that the grains tend to accumulate in rows in front of each pole piece. This difficulty was overcome by placing a few strips of electric tape across the drum parallel to the axis. Covering the drum with canvas was also tried, but, while this gave good results in dry concentration, it carried too much non-magnetic stuff when run wet.

The magnetic field utilised in the separator is the stray field. As first designed, the gap between the pole pieces was made quite small, with the result that a large current was required to produce a sufficient strength of stray field outside the cylinder. The gap was then widened, giving better results. It is now proposed to further increase the air gap between the pole pieces, and enclose the whole working side of the apparatus in an external shield or armature. This will cause a stronger and more even field to pass through the drum, or will make it possible to secure the present strength of field with far less current.

The only dry run that has been completely assayed was on a sample of sand containing about 57% metallic iron and 16·2% TiO_2. It is probable that the major part of the titanium was in the form of ilmenite. Some may have occurred as rutile, and some no doubt was contained in minute grains of ilmenite enclosed in magnetite. Assuming that the titanium occurred as ilmenite ($FeTiO_3$) the 16·2% of TiO_2 had combined with it 16·2 x 56/80 = 11·3% of iron, so the amount of iron capable of being magnetically separated from the titanium would be only 57·0—11·3 = 45·7%. If rutile (TiO_2) was present, the percentage of iron free from titanium may have been more. If much titanium was enclosed in magnetite the free iron may have been less.

As preliminary work, several field strengths were tried. The weakest used, gave practically no concentrates, while the strongest took out nearly all the titaniferous material as well as magnetite. As magnetite has a much higher magnetic permeability than ilmenite. There should be some strength of field at which the heads product obtained contains almost all the magnetite and very little ilmenite. Unfortunately, grains of ilmenite cannot be distinguished by the eye from grains of magnetite and assays for titanium in the heads and for iron in the tails should have been made to show what were the limiting amperages for successful concentration. In the test in question, this was impracticable, and a current of seven amperes was used.

The result from 52 lbs. of sand was 22 lbs. of heads assaying [illegible] and 30 lbs. of tails assaying 45·30% of metallic iron

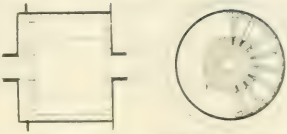


FIG. 2. SECTIONAL ELEVATIONS OF SEPARATOR.

the heads of 65% of the total free iron, the heads carrying less than 1/16 of the titanium. A considerably better recovery than this could have been obtained with a slightly higher amperage, and no harm done to the product, as iron ore having 2·5% of TiO_2 or under is not objected to by blast furnace people.

A screen analysis of 43¼ lbs. of tails from a somewhat similar dry run showed:—

(1) Remaining on an 80 mesh sieve ... 9¾ lbs.
(2) Remaining on a 100 mesh sieve ... 27¾ lbs.
(3) Passing through a 100 mesh sieve 5¼ lbs.

Assays of these three sizes showed:—

	Fe	TiO_2	[illegible]
Over 80 mesh.	[illegible]	[illegible]	[illegible]
80 to 100 mesh.	[illegible]	4·5	[illegible]
Under 100 mesh.	[illegible]	1·5	[illegible]

The capacity of the machine dry is about 300 lbs. per hour. Its resistance as used is 3 ohms, so the magnets with seven amperes passing required about 150 watts or 1/5 h.p. It takes less than 1/5 h.p. to drive the cylinder, so the total consumption of power is less than one-half h.p. A large machine designed for economy of power could easily do equally good work with one-half or one-third of the current and power per unit weight of sand, viz., from 100 to 150 watt hours per 300 lbs. At 10 cents per killowatt hour, this would amount to 7 to 10 cents per ton of sand. The capacity can probably be further increased by running any but very rich sands very fast, so as to make a large amount of poor heads, and then cleaning these heads by re-running them.

Run wet, the machine will probably duplicate the work it does dry, but the adjustments need more careful watching and the capacity is lower. Six wet runs on sands from Seven Islands gave heads containing 1·10, 2·36, 2·30, 1·48, 1·48, and 1·67% of TiO_2. Preliminary runs on each ore and numerous assays are necessary for the determination of the adjustments required. A wet run for the exhibit of the Quebec Government at the Liége Exhibition, which had to be done without assays or sufficient preliminary work, gave concentrates carrying 7·13% of TiO_2. This sand was practically identical with that used in the six wet runs mentioned [illegible] heads. The assays made after the test was completed are as follows :—

Heads	Metallic Iron	64·31%
	TiO_2	7·13
Tails	Metallic Iron	44·95%
	TiO_2	20·17%

The weights were

Heads	27 lb. 12 oz.
Middles (not exhibited)	3 lb. 10 oz.
Tails	27 lb. 11 oz.

61% of the free iron was got into the heads with about 1/5 of the titanium. The sand was the same as that used in the dry run previously described, and is practically identical with that which gave such excellent results when preliminary assays were made.

The capacity of the separator wet is about 100 lbs. per hour. About 0.02 cubic foot of water per minute is required to reduce the damp sand to a pulp, and about 0.10 cubic foot per minute to wash the tails from the heads. Sometimes water is used for cleaning the heads and tails from the bottom of the cylinder and sometimes not. The water could easily be pumped back and used over and over. The total power used in the present small machine when running wet costs on an average about 50 cents per ton of sand, but on a large machine this could certainly be cut down to one-half or one-quarter that amount. The separator either wet or dry is usually run at 87 revolutions per minute. The amperages used range from 3 to 11, 5 and 7 being the commonest.

The machine used in the above tests was designed by Dr. J. B. Porter, Professor of Mining Engineering, and built in the shop of the Mining Department of McGill University. The work detailed was all done under his advice and general direction, but great credit is due Mr. R. A. Chambers, a former student, for tests which he carried out on the Seven Islands sand. The author is responsible for the more recent work, and thanks are due Mr. J. Obalski, the Mining Engineer of the Province of Quebec, for material. The chemical analyses were nearly all made by Mr. M. L. Hersey, Provincial Analyst, by authority of Mr. Obalski. The main part of the sand was furnished by Mr. William Robertson, of Montreal, but the Seven Islands sand came from Mr. Ganong, of Quebec. The wet and dry tests last made were carried out at the suggestion of Mr. Obalski, and samples of all products were included in the Canadian Exhibit at Liége this year.

A set of samples of the sand sent to Liége included :—
(1) Original sand ; (2) heads of dry concentration ; (3) tails dry concentration ; (4) heads of wet concentration ; (5) middles of wet concentration ; (6) tails of wet concentration.

Read before the Canadian Society of Civil Engineers

SWANSEA DESTRUCTOR.

THE five-cell Horsfall destructor plant at Swansea has just undergone its official trial, with the following results :—

Duration of test, 23 hours ; total quantity of refuse burned, 70 tons 16 cwts. ; total quantity per cell per 24 hours, 14 tons 15 cwts. ; total quantity per man per shift, 7 tons 17 cwts. ; rate of wages, 5s. 6d. per shift of eight hours ; cost of labour per ton, 8·4d. ; total water evaporated, 15,500 gallons ; total water per lb. of refuse from and at 212 deg. F., 1·20 lb. ; steam pressure maintained, 176 lb. ; horse power developed at 20 lb. steam per i.h.p. per hour, 336.

Connected with the destructor is an electricity sub-station, containing a 225 K.W. British Schuckert dynamo, coupled direct to a marine triple-expansion open-type engine by Messrs. J. and H. MacLaren, of Leeds, running at a speed of 150 revolutions per minute, and capable of developing 450 i.h.p. This machinery operates 4½ miles (route length) of electric tramway. The steam is provided from the destructor boiler, and there is no other boiler on the works. The destructor boiler is, however, provided with a furnace in which a small quantity of coal can be burned if required.

It has been demonstrated that the destructor is fully capable of operating the length of tramway without assistance except on Saturdays, when a very small quantity of coal has to be occasionally burnt in order to meet the peak of the load. Steam raised from refuse also supplies the forced draught to the destructor, and the power for the clinker crushing machine and mortar mill engine. The destructor is therefore doing better work than was claimed for it, either by the promoters of the scheme or by the contractors, before its erection.

THE GARVINS FALLS DAM, CANAL, AND HYDRO-ELECTRIC PLANT, BOW, N.H.

By George G. Shedd.

ALTHOUGH the power at Garvins Falls, four miles below Concord, N. H., is one of the best on the Merrimack River, it has only recently been fully developed. There has been a dam here since 1815, when a wooden crib dam was built in connection with the Bow Canal, which was the only means of transportation until the advent of the Concord Railway in 1835. In excavating for the new canal, portions of the old wooden lock-gates were unearthed and found to be quite sound after nearly ninety years' service. A stone dam was built here in 1859, the centre portion of which was carried out by the following spring freshet and was not rebuilt until 1879, when, in order to preserve flowage rights, the destroyed portion was replaced with a timber section. This remained until the old dam was destroyed at the completion of the new dam. A pulp mill at the site of the new station utilised a small part of the power here for a number of years. The city of Lawrence, Mass., narrowly escaped being located at Garvins Falls, for its promoters thought very favourably of the situation and power, but could come to no satisfactory terms with the owners of the property or with the town of Bow.

The absolute minimum flow of the river is probably about 1,000 cubic feet per second, but only on very rare occasions is the flow less than 1,300 cubic feet per second. This gives 4,279 gross h.p. under a 29-ft. head, or 3,218 h.p. as the ordinary minimum on switchboard, allowing 80 per cent. efficiency of turbines and 94 per cent. efficiency of generators. It is expected from past records that the river will furnish at least 5,000 net h.p. for nine months in the year and for a large part of the time considerably more than this, the average power for the entire year being in excess of 10,000 h.p. It was therefore decided to develop for 6,000 h.p.

GENERAL FEATURES OF THE SCHEME.

As the company's need for power was rather imperative, it was decided to utilise the old dam and canal and build a portion of power station which would be a part of the permanent development. This was completed in June, 1902, and furnished about 1,200 h.p.

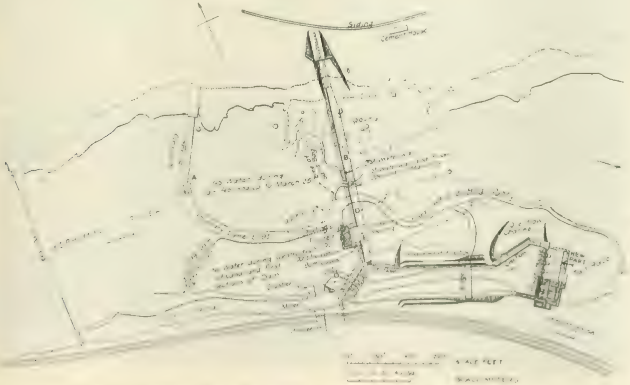


FIG. 1. GENERAL PLAN SHOWING LOCATION OF CONSTRUCTION PLANT.

Early in 1905 it was decided to complete the development. Accordingly, plans were made for new dam, canal, head gates, etc., and for the completion of the power station, and a contract was let on June 5 to the Holbrook, Cabot and Rollins Corporation of Boston.

The work consisted of building an overfall dam of the ogee type with a maximum height of 33 ft., 550 ft. long between abutments and about 800 ft. over all, including head gates; a canal about 500 ft. long and 74 ft. wide at water line, closed at river end by a massive head-gate wall; and making extensive addition to power station. The location of head gates was practically fixed by the ledge, which furnished good foundation there, but dropped off very materially just above on the line of the old canal.

The rating of this dam as well as of the wheels has lately been undertaken in co-operation with the United States Geological Survey, so that we expect to have some very accurate records of flow of the Merrimack at this point as well as to obtain data on co-efficient of discharge, which seem to be rather scarce, particularly on the high heads.

The length of the old dam was 454 ft. between abutments and 473.2 ft. on crest, measuring all offsets of wooden centre sections. The length of the new dam was, therefore, fixed at 475 ft. on low crest portion at same elevation (or rather 0.06 lower to allow for slope in river) so as to avoid all legal questions as to flowage rights and at the same time to maintain all the head to which the company is entitled at the low stages of the river. In order to keep the water level down and avoid trouble with railway, etc., during freshets, an additional length of spillway of 75 ft. at a level 2.0 ft. higher was provided.

DETAILS OF DAM

As the general level of ledge is about 83 (referring to low crest level as 100) for a considerable distance on both sides of the channel, the toe stone level was made El. 84 except at the ends, where the ledge is higher, and it was stepped up to fit the ledge. For about 75 ft. in the centre there is a channel with a depth of 10 or 12 ft. lower than the general level. Several methods of treating the toe at this place were considered, but the one adopted consisted of building an apron of rubble on approximately a sloped [illegible] from top of toe stone, which was flattened out at the bottom to fit the ledge and surfaced with a heavy cut granite facing, the stretchers being at least 2 ft. thick with headers of from 4 ft. to 5 ft. in length.

The hearting of the dam is built of rubble masonry laid in 2·5 to 1 Portland cement mortar. The stones were as large as could be conveniently handled, with a maximum size of 2 cubic yards or more, and more or less irregular in shape, laid on a thick bed of mortar and far enough apart to insure a good vertical joint. These joints were filled with a rather wet mortar into which were forced as many spalls as could be. Particular care was taken in this respect, because it has been observed in taking down masonry of a similar class that if any poor work occurs it is almost invariably in the vertical joints. The stone used for hearting was largely a coarse-grained granite obtained from the canal and dam excavation, although some mica schist from excavation was used which was found to be heavier than granite.

The upstream facing is of granite rubble well bonded to the hearting. The downstream facing is of heavy ashlar. The stretchers have a minimum depth of 2 ft., a minimum length of 3 ft., and a rise of from 18 in. to 24 in. The headers, which were placed alternately between every two stretchers in each course, were at least 4 ft. long with a minimum face length of 2 ft. The total face area of headers is about one-sixth face area of each course. Capstones are 2.5 ft. deep at crest and at least 4 ft. long. Toe stones are very heavy, being at least 4 ft. long, 4 ft. deep, and 3.5 ft. on face.

The foundation ledge was so seamy that the original plans of cut-off trench could not be strictly followed; it was usually somewhat wider, with the downstream face taken out on more or less of a slope depending on the seams encountered. The foundations were everywhere carried down to good solid ledge and all loose rock was removed by barring and wedging. Before

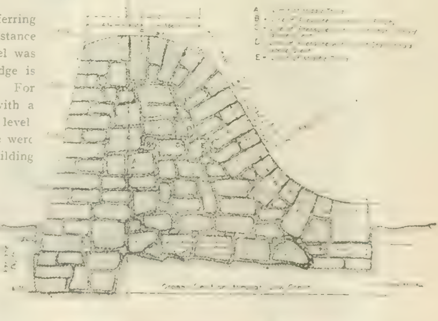


FIG. 2. LOW-CREST PORTION OF MAIN DAM.

laying masonry the ledge was thoroughly washed and all seams were grouted.

METHOD OF CONSTRUCTION.

Work on the dam was commenced on the foundations at both ends in August, and the first stone was laid on September 8, 1903, near north abutment. The ledge was very seamy and required great care in blasting. There is a small low island just above the dam site which is entirely submerged at high water, but at ordinary water divides the stream into two parts, by far the larger portion following the channel in the centre of the river. Advantage was taken of this by the contractors, who first closed the channel on the south side of the river at the head of the small island referred to, by building a sand-bag cofferdam from 4 to 8 ft. high and 200 ft. long, and also building a low cofferdam along the centre of the island. This permitted them to build the head gates, south abutment and about 145 ft. of the dam foundation comparatively free from water. Two sections of about 50 ft. in length at the south end of the dam were built to full height, and a gap left between of about 60 ft., with foundations in to about the level of the ledge. This gap was opposite the channel on the south side before referred to, and was designed to take at [illegible] water [illegible] the water that [illegible] through the canal.

After these sections were in and the headgates and south abutment above water, the sand-bag dam was removed and a cofferdam built from the head of the island across the main channel to the north shore about 400 ft. above the dam. This would have been quite a proposition at any time of the year, but it was especially difficult in the cold weather of December and January, anchor ice and a foundation of boulders making it hard to get a tight job. It was satisfactorily accomplished, however, early in January, and the water diverted to the south channel.

In the meantime work on the dam had been going on at the north end, where it was now nearly of full height for a distance of 160 ft. from the north abutment. This left a centre section of 245 ft. to be built.

As the company was anxious to use power at the earliest possible time and the spring freshets were almost certain to destroy the cofferdams, it was decided to push work through the winter while the water was low, and to attempt to raise the centre section to such a point before freshets came that in case the cofferdams were carried out, the dam would be high enough of itself to divert the low flow through the gap at the south end previously mentioned, and that the work could proceed after the freshets had subsided without rebuilding coffers. If this could be accomplished, at least six months could be saved. Accordingly, every energy was bent on getting the foundation prepared,

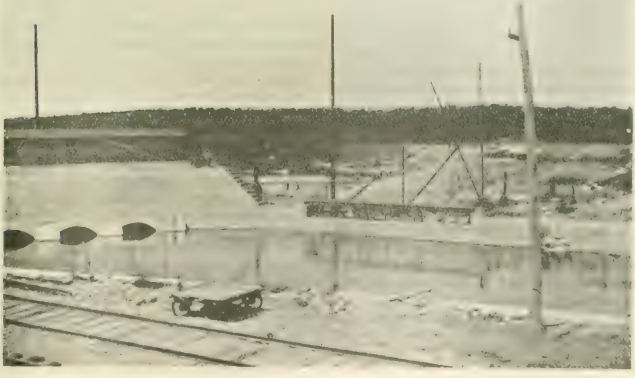


FIG. 4. DAM AND HEADGATES, [illegible] 1904.

which proved to be no easy task under the almost arctic conditions then prevailing. As soon as a section of foundation was prepared, all the masons that could be conveniently worked started on the masonry. The foundation was put in for the whole width of the section up to the level of bottom of toe stones, and then the upstream masonry approximating about one-half the thickness of the dam was carried up to El. 92, or 8 ft. below crest. At this elevation it was expected that there would be sufficient waterway together with the canal and 60 ft. gap to handle an ordinary spring freshet without danger. The flow was expected to be deep enough to pass ice over unfinished masonry without damage.

The leakage from the main cofferdam was collected by several lines of sand bags and carried across the foundation in a channel prepared for it over the ledge at G, fig. I., allowing the foundation to be put in on both sides. The flow was then shifted to a point (H) over the masonry and finally back to the first location, where in the meantime the foundation had been completed and a gap 8 ft. wide left in the masonry above the foundation, which was not closed until just previous to effecting the final closure at E. Provision for closing this 8-ft. gap was made by building a 12 by 12 hard pine timber frame into buttresses built out about 3 ft. from the face of the dam, against which was later placed 4-in. tongued and grooved sheeting driven into sand bags at the bottom.

By the 10th of March the masonry was up to El. 93 or higher everywhere, except at the two gaps noted; and all derricks and machinery were moved from the river bed in preparation for the freshet which was expected at any time, but did not come until the 28th of March; it caused a flow of 9 ft. over the crest of the unfinished centre portion, which stood the test without the slightest damage. Of this masonry the last portion had been finished only eighteen days and no portion over two months, during which time the temperature ranged down to 24 degrees below zero, which would seem to prove that Portland cement masonry construction can be successfully carried on in freezing weather if proper precautions are observed.

EFFECTS OF FREEZING MORTAR.

A series of experiments on the effect of freezing mortar was made during the progress of the work. The mortar used was of 1 part Lehigh Portland cement to 2·5 parts sand, and was taken from that being used at the dam. The mortar for each experiment was made into fourteen briquettes, half of which were placed in water in the office and the rest placed out of doors in the air. The sand and water were both heated, and salt was used in the water in the proportion of 4 lb. to a bbl. of cement. The average temperature during the period of these experiments was considerably below freezing, and in some of the first experiments the briquettes were frozen continuously for over three months, but seemed to gain in strength at about the same rate as those that were thawed out earlier. In one case a temperature of 24 degrees below zero fahr. occurred within 12 hours after the briquettes were made, but the final strength was not affected. The results of experiments made between November 28, 1903, and February 27, 1904, are as follows:—

TENSILE STRENGTH.

7 DAYS.		28 DAYS.		3 MONTHS.		6 MONTHS.	
Water.	Air.	Water.	Air	Water.	Air.	Water.	Air
In lab.	Outdoors	In lab.	Outdoors	In lab	Outdoors	In lab.	Outdoors
203	90	247	173	314	320	374	403

It will be seen that at periods up to about three months the strength of the frozen mortar is materially reduced, but at three months it is fully equal to mortar that has not been frozen; while at six months it appears to be even stronger. This same increase was observed by Mr. T. F. Richardson in an elaborate series of experiments made at the Wachusett dam, an account of which he has recently published.

Masonry work was carried on at the dam when the temperature was as low as 5 degrees fahr., but the following precautions were observed whenever it was below freezing: the sand and water were heated, salt was used in the water to the extent of 4 lb. per bbl. of cement. All large stones and spalls were thoroughly steamed before laying. Great care was taken to have the surface of old work thoroughly cleaned of all ice and dirt. At night all fresh work was covered with large tarpaulins and a steam jet kept under them.

COMPLETING THE CENTRE SECTION.

Work was finally resumed upon the centre section of the dam on May 25, 1904, after several unsuccessful attempts on account of high water. At this time there was about a foot of water flowing over the uncompleted portion. A sand-bag coffer was placed on the top of the dam and at the upstream edge of the masonry and work carried on behind it until the water receded enough to all pass through channels prepared for it. It did not take long to complete the centre section in this manner, close the 8-ft. gap previously spoken of, and build the apron at the toe, after which it became necessary to close the 60-ft. gap at the south end.

The contractors had here previously built masonry buttresses on each side of the opening, extending about 15 ft. upstream, and also prepared a foundation for the closure crib. The lower trusses of this crib were floated into position successfully on July 15, and it was gradually built up above water and loaded with stone, after which the sheeting was driven, allowing water to rise and flow over the new dam.

The masonry in the final closure was completed on August 14, about eleven months after the first stone was laid and one year after work was started. After the dam was completed the old dam was destroyed by dynamite.

THE CANAL.

The new canal, which was started June 8, 1903, was practically an enlargement of the old canal; it is about 200 ft. long and 74 ft. wide at the water line, with a depth of 12 ft. below the crest of the dam and a total depth of 17 ft. at head of canal, 18 ft. at head of fore bay and 22 ft. in fore bay. It was designed to furnish 2,900 cubic feet per second, with a mean velocity of 3·55 ft. per second when water was at the crest of the dam. Under these conditions the loss of head in the canal was calculated to be ·07 ft. due to velocity.

POWER STATION.

The station is a brick building on a granite foundation, containing seven arched openings, six of them about 15 ft. wide, to allow tailwater to pass freely from draft tubes to tailrace. The generator room is 30 ft. by 146 ft. wide, with floor level at grade 35. As the backwater has been known to be somewhat over 5 ft. above this elevation, it was waterproofed to a point 7 ft. above the floor. The wheel room between the fore-bay wall and generator room is 33·5 ft. wide, in which the water may rise at periods of unusually high water. The shafts from the wheels are located in this room, passing through stuffing boxes in water-tight bulkheads in the wall of the generator room.

The station is designed to contain 6 units rated at 650 kw. each. Four of these are at present installed and the other two will probably be put in in the near future. A steel rack 20 ft. high with 3·5 in. by 0·25-in. bars spaced 1·25 in. apart is placed just above fore-bay wall to protect the wheels. This is designed strong enough to act as a dam in case it is clogged by anchor ice and the water drawn away from behind by wheels. A short tailrace is provided from station to river in which the loss of head is about 0·5 ft. In constructing this the greater part was done by team work and the balance by dredge.

CORRESPONDENCE.

To the Editor of Page's Weekly.

Sir,—The chief improvements which have been carried out on the River Weaver in recent years are the completion of the enlargement of the locks, which are now 220 ft. by 42 ft., and 15 ft. of water on the sills, and also two swing bridges at Northwich, which take the place of an old so-called fixed bridge at that place. Owing to subsidence the so-called fixed bridge was gradually reducing the headway, and, although it had been raised two or three times it was impossible to meet the requirements of the traffic without opening bridges. These were built by me in 1899–1900, and were fully described in a paper to the Institution of Civil Engineers in 1901. To meet the requirements of the subsidence they were built on pontoons, so that the weight did not rest on the ground, and they could be easily adjusted, and they were also, I believe, the first bridges in the Kingdom to be worked by electric power.

I am now engaged in carrying out an improvement to the Anderton hydraulic lift, which, as you know, lifts the canal boats from the Weaver to the Trent and Mersey Canal, through a height of 50 ft. at Anderton. This lift has been at work somewhat over thirty years, and being built of iron and steel, exposed to the continuous action of water, naturally requires repair. The most economical way of carrying out such repair, it has been decided, will be to adopt a plan of balancing the troughs by a number of counterweights and operating the whole by means of electric motors. This plan has been patented by myself, and will, I fully hope, lead not only to an improvement in the working capacity of the lift, but also to greater ease of carrying out repairs when necessary at a future date.

I am very fully convinced that if the scheme, or something approaching it, laid down in my paper to the Institution of Civil Engineers, could be carried to at a reasonable cost, and there is little doubt that the cost of barge canals has previously been somewhat over-estimated, the gain to the country would be very great indeed, and would be obtained without in any way injuring the existing railways, which would be relieved of traffic which is more readily carried by water.

I do not advocate building more than barge canals capable of taking barges of 250 tons, as the enormous number of bridges, both railway and road, which have to be encountered, render anything in the shape of ship canals, with vessels of fixed masts or funnels, practically out of the question.

Yours truly,

J. A. Saner.

From a paper read before the Boston Society of Civil Engineers.

TECHNICAL SOCIETY NOTES.

An interesting paper on "Worm Contact," the publication of which is commenced in this issue, was read before the Institution of Mechanical Engineers on Friday last. The presentation of this paper is extremely opportune. Experimental investigation of the actions involved with worm gearing has been singularly incomplete, although many writers have contributed to the theory of the subject. Notwithstanding that much has been written it is certain that some of the most interesting aspects of the question have been overlooked or ignored, with the result that there is no single source from which a complete account of the action of worm-gearing can be gathered.

Mr. Bruce has attempted, with a good deal of success, to rectify some of these omissions. It was, for more than one reason, a pity that the discussion on the paper came at the tail end of a rather long evening and was therefore all too brief. Mr. Major pointed out that the difficulty which engineers had in dealing with the subject arose from the attempt to design a worm gear on the same lines as spur gearing. The whole subject requires further investigation and the appeal made by Mr. Bruce for a committee in connection with one of the technical societies is worthy of attention. No private experimenter could possibly afford to carry out the vast amount of work necessary to complete our knowledge of worm gearing. There is little doubt that research work would enable much larger working pressures to be realised.

At the meeting of the Institution of Mechanical Engineers on Friday last the discussion on Mr. Izod's paper, "Behaviour of Materials under Pure Shear,' was continued. Prof. Carus Wilson, who resumed the debate, insisted that the ultimate resistance of any material to rupture was the resistance it offered to change of shape, and not the resistance to a mere longitudinal pull. With cast-iron of course the chain of events was different, and the conditions so extremely complex that he had always regarded shearing experiments on that material with great distrust. With plastic materials only could reliable results be secured in shearing tests.

Professor Unwin was of opinion that the data in the paper would prove useful to practical engineers. He pointed out that punching was being studied by French investigators as a useful test to employ in workshop determinations of the value of materials. [illegible] towards connecting the tenacity of materials with the results obtained by the shearing test. Mr. J. P. Stromeyer discussed compound stresses. From a machinery user's point of view he claimed it was highly important that the subject of compound stresses should be investigated. Clearly the results of a research in this direction would be a great aid to those who have to design machinery.

Mr. Wicksteed, who also took part in the discussion, described some shearing experiments he had made and by the aid of diagrams described what took place when a bar was being sheared. The process of shearing he finally defined as a gradual one. At the beginning of the shear the resistance of the bar was much greater than its resistance to compression, and that process continues until the reduction in area made the bar more easy to shear than to undergo further compression. Mr. Izod not being present, his reply on the discussion will not be available until it appears in the transactions of the Institution.

In an excellent contribution to the proceedings of the Institution of Mining and Metallurgy, Dr. O. J. Steinhart has summarised some of the available information as to the metals and their ferro alloys which are used in the manufacture of alloy steels. Dr. Steinhart does not deal with the ferro alloys of manganese or with silicon, but to nickel, chrome tungsten, molybdenum and vanadium he devotes a good deal of attention. He points out that the consumption and production of nickel is steadily increasing and estimates this year's output at about 13,000—14,000 tons, all of which, however, is not used for steel but for other purposes, such as nickel plating, German silver, other alloys, and coins. With regard to the cost of manufacture of nickel from the usual seven per cent. ore, the following figures obtained from private sources may be taken as fairly correct per ton of marketable metal :—smelting and bessemerizing, £45 ; grinding and calcining, £5 ; reducing, £5 ; making a total of £55. It is interesting to note that small quantities of magnesium are often used to purify the molten metal, rendering it malleable, besides making it very fluid before casting.

Ores for the production of ferro-chrome should be as pure as possible and free from silica, as the latter element has a tendency to enter into the alloy instead of going into the slag, when smelted in the electric furnace. A suitable ore which should contain at least 50 per cent. of Cr_2O_3 is easily obtainable and New

Caledonian ores of 5[illegible] per cent. are by no means uncommon. They can be bought for about 7[illegible]s. per ton at convenient English or Continental port with a corresponding increase in price for each unit above 50 per cent. Ordinary ferro-chrome with about six to eight per cent. of carbon can be made for £15 per ton. Ferro-chromes, with less than one per cent. carbon will fetch £150 per ton.

The ore most suitable for the production of tungsten is wolframite. Although found in many places, such as Queensland, New South Wales, Straits Settlements, Bohemia, Cornwall, Spain, U.S.A., etc., it does not occur in large masses, and is often very pocketty. In the pure state it should contain over 70 per cent. WO_3, but such ores are not plentiful, and the average grade runs between 60—70 per cent. tungstic acid WO_3. The manufacture of metallic tungsten powder 96–98, as now employed by the steel maker, is in the hands of about half-a-dozen German makers and seems to have first been perfected at some of the Hanoverian works. Molybdenum, which resembles tungsten, is much more difficult to prepare in the pure state and the effect it has upon steel has been by no means finally settled. According to some manufacturers wultenite is the best raw material for the preparation of suitable metal. It is first melted with soda ash and carbon, resulting in the formation of metallic lead and a fused mass of molybdate of soda from which molybdic acid is separated. The latter is then reduced with carbon in crucibles very much like tungsten, yielding a grey metallic powder of about 95 per cent. purity with two to three per cent. carbon, and a considerable quantity of undecomposed oxides, by no means an ideal product.

Mr. R. A. Hadfield, who opened the discussion on the paper, said that it brought the knowledge of the subject right up to date. The president of the Iron and Steel Institute went on to give those interested in the subject some advice. Referring to the impending rise in the price of manganese and nickel, he expressed the hope that those who were concerned with the production of these special steels would not be hampered by prices being advanced unnecessarily. He also pointed out that a number of people who sold alloys had an altogether mistaken notion as to the carbon contents. Nearly all steels required carbon, and a certain percentage in the alloys was not, therefore, injurious. Nothing had been done seriously as regarded the use of tungsten for armour-plates, chrome being at present [illegible]. He thought that [illegible] who, like the author of the paper, had brought these alloys under the notice of the steel-maker.

Sir Marcus Samuel delivered the presidential address at the Institute of Marine Engineers on Monday evening last. He took for his subject the applicability of the internal combustion engine to marine requirements generally, and also enlarged upon the advantages of using liquid fuel. His firm, it appears, are at present engaged on a contract in connection with Japanese turbine boats which are to be fitted for the use of liquid fuel. A scare had been raised, he added, as to the possible supplying of benzine, but he could see no possibility of a demand arising which would overtake the supply within a reasonable space of time. At the conclusion of his address, Sir Marcus presented the Denny Medal of the Institute to Mr. J. R. Roberts, for his paper on "The Application of Electrical Power to Cargo Steamers."

Referring to the description of the Acme Combined Concentrating Table in the paper read before the Institution, and published in our last issue, the following particulars of the mode of working will be of interest:—

The ore from the mine, after suitable reduction, was fed into the mortar boxes of the Californian stamps, leaving them through a "30" mesh punched screen. It then went upon the Frue vanners; the concentrate thus obtained after passing over upward current classifiers, was settled in pits and calcined in a Brunton calciner, 14 ft. in diameter. The calcined concentrates were then mixed with water and run into a classifier, the sands going to separate buddles. The middlings from this buddle constituted the material used in the trial about to be described.

The author took samples from: (*a*) the overflow from the upward current classifier as the ore flowed to the table; (*b*) the tailings launder as the stream flowed through the holes to the settling tanks; and (*c*) the concentrates coming off the table before entering the central launder. The samples so taken were allowed to settle in their respective buckets, the supernatent clear liquid was drained off, and the samples collected and dried. The author then took them away for assay.

The assays of the low grade samples were made by vanning, and the concentrates by the cyanide method. The impure cassiterite known as "black tin" was found to contain 75 per cent. Sn, so that the results are [illegible]

NEW DESIGNS AT MESSRS. YARROW AND COMPANY'S WORKS.

WE illustrate on page 205 a double-ended boiler constructed by Messrs. Yarrow and Co. for the Spanish Government. Hitherto these boilers have been fired from one end only, having at the back the customary wall and the necessary double casings and asbestos to protect it. A double-ender, however, avoids this additional weight and the constant repair incidental to firebrick surfaces. It also enables the units to be increased in size and, as a consequence, simplifies all the steam and feed pipes. It is thought that this type of boiler may lead to a revision of the policy of boiler subdivision.

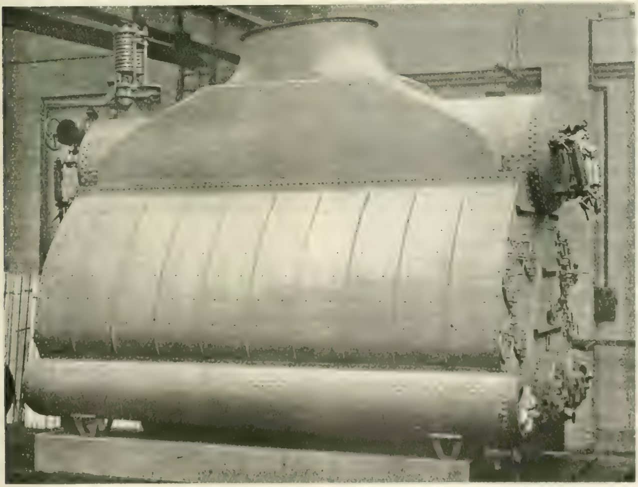
Two or three such double-ended boilers, with a single stokehold at each end, in one boiler compartment, together with cross-bunkers and side-bunkers, would make a very complete and simple boiler installation. Substituting a double-ended boiler for two single-ended boilers reduces the weight by about 12 per cent., which, together with the simplification of the feed and steam pipes, offers advantages which deserve the attention of naval designers.

Considerable interest centres in a new motor-boat which has been experimentally constructed by Messrs. Yarrow and which has been viewed by the naval representatives not only of this country but of France, Germany, Italy, Spain, and Greece. A representative of PAGE'S WEEKLY has had the opportunity of participating in a trial run of the boat, and can therefore speak from personal experience of the behaviour of the craft under high speeds. The boat may be classified as a "second-class torpedo boat." It is strongly built, being 60 ft. long by 9 ft. beam, and cannot be looked upon in any sense as coming under the category of a "racing boat," which is generally built simply to win a race and then possibly collapse. The launch in question is a thoroughly practical craft and in every respect quite as durable as a second-class torpedo boat, which, up till now, has been fitted with steam machinery. The machinery in this launch consists of three sets of internal combustion engines, driving three screws; each of the two outer propellers are driven by engines of about 120 h.p., and the centre propeller is driven by an engine of 60 h.p. The two outer propellers are only capable of going ahead, while the central engine can be reversed, it being considered that this amount of reversing power is amply sufficient. The engines are constructed from designs by Mr. Napier.

On a series of trials the light speed has been found to be 25½ knots which, for a boat of these dimensions and strength, is unprecedented, and foreshadows a further advance with vessels of larger size. The best speed that could be obtained under the same conditions with steam would be 20 knots, showing an advance of 5½ knots. This increased speed is no doubt due to more than one cause. Firstly, the much lighter weight of machinery of the internal combustion type as compared with steam; probably the saving in weight is 50 per cent.; secondly, the form of hull, which at these extreme speeds, for the displacement of a boat of this type, seems to enable it to rise on the surface of the water, and as it were to some extent slide on the surface. This is made evident by the small surface disturbance of the water, which is very remarkable. Thus the portion of the power which is usually expended in producing surface disturbance or what is called "wave-making" is utilised for propulsion. Such a launch would be admirably adapted to serve as a second-class torpedo boat, if fitted with "a revolving torpedo tube," so as to discharge the torpedo over either side, or it might be fitted as a gunboat for coastguard service to chase smugglers. Owing to its light weight, which, including the hull and propelling machinery, would not exceed eight tons, it is quite easy to send such a craft on board a vessel for export to almost any part of the world. If such a launch be fitted with torpedoes, it certainly does appear to be eminently adapted for the defence of a port or a coast; and it may well be a question whether a certain amount of money would not be more advantageously expended in obtaining a large number of such craft rather than a few vessels of larger size. For example, the cost of one modern destroyer is equal to that of about 15 such torpedo launches as described; and fifteen small vessels of high speed, which it would be difficult to hit, offer a much greater means of defence than one destroyer of large size, unprotected, upon which the fire of a number of guns could be concentrated.

Any risk that is attended with the use of petrol has been minimised in the launch under consideration. The petrol tank is placed on the after part of the hull, and does not form part of the hulls, being quite distinct from it, so that in case of damage to the petrol tank the petrol would simply flow over into the sea, and not into the boat, and in case of any conflagration the flame, when the boat is travelling, would pass away from the hull.

There is another point in connection with the use of launches of this kind, that the number of the crew working the machinery is about half that which is needed if propulsion is by steam, and in the event of such a craft being sunk the loss of life would be reduced.



DOUBLE-CYLINDER BOILER CONSTRUCTED BY MESSRS. YARROW AND CO., LTD., FOR THE SPANISH GOVERNMENT.

THE HOWARD LECTURES.

HIGH-SPEED ELECTRIC MACHINERY WITH SPECIAL REFERENCE TO STEAM TURBINES.

THIS subject is one of real interest, and Professor Silvanus Thompson's choice of it for the Howard lectures before the Society of Arts is a very happy one.

In the first of the three lectures, which comprises the series, delivered on January 18th, Professor Thompson dealt with problems of electric design as affected by speed and rated output.

Many factors, he pointed out, entered into the problem of the economic generation of electric energy, it being dependent on the cost of the prime power which served a source, and on the type of prime mover adopted. When electricity first began to assume a commercial aspect, no engineer dreamed of driving a dynamo by any other method than by applying a pulley to its shaft and belting this pulley to a pulley on the shaft of a steam engine, either directly or through some countershaft. The steam engines of those early days were almost without exception slow speed engines, while the early dynamo required high speeds, and there was no choice but to drive by gear or belting. It was foreseen, of course, that sooner or later direct driving must supersede belt driving, yet the large stations which grew up by hundreds in the United States were marvels of engineering at cross purposes, the engine builders having their standard slow-speed engines and the dynamo builders their standard high-speed dynamos. It was clear that development might come in either of two directions ; the electric generator might be designed to suit the slow-speed engine or the engine might be developed to suit the high-speed generator. Progress took the former of these courses on the continent, where the large slow-speed type of generator was evolved. In the meantime, the opposite kind of development was going on in England. Yet all the while a new invention had been in process of evolution in the shape of the steam turbine, and in spite of the improvement which had taken place in the high-speed reciprocating engine, it soon began to find a formidable rival. In the [illegible] turbine, which with its high peripheral velocities, simplicity of lubrication, economy of space, and absence of vibration, offered certain advantages over any reciprocating engine. Other influences were at work in the same direction. The introduction of motor generator sets in sub-stations for converting from high voltage alternating to low voltage continuous currents, gave another cause for the adoption of high speeds and independently led to new types of high-speed generator. Various factors influenced the output which could be obtained from an electric generator of given construction, and the recommendations of the Engineering Standards Committee defined the conditions that should govern the rating of the normal output of generators.

DESIGN AND COST.

That being so, the question to be considered was in what relation the rated output stood to the design of the machine and its cost, and in what way these were affected by the engine speed. Manufacturers were naturally desirous of producing as cheaply as possible the machines that were to fulfil the required specification. There were certain fundamental formulæ which stated the dependence of the electro-motive force of the generator upon the speed, the number of armature conductors and the flux per pole. Different designers had different ways of looking at the output of machines. Some assumed a certain number of kilowatts per pole, but this was by no means a safe guide save for some very narrow range of machines. The late Mr. Sydney Short had proposed a method by which the poles of all machines were to be of the same size, the output being in all cases 68.5 kilowatts per pole, and the parts interchangeable, but this tended to impose arbitrary conditions upon engine builders, and the scheme was not practical. Another mode of regarding the design of electric generators originally due to Mr. H. A. Mavor, employed the conception of the active belt. It was obvious that the whole of the electro-magnetic actions occurred in a very narrow belt of the armature, and this was what Mr. Mavor termed the active belt.

The specific utilisation of the materials of the active belt depended on three factors only (apart from the numeric [illegible]) viz. the peripheral speed, the gross electric density, and the gross magnetic density. As it was clearly to the interests of the manufacturer to use as little material as possible for obtaining the prescribed output, and it was clear that he ought to aim at having as few cubic inches as possible per kilowatt of output, or getting as many watts of output as possible per cubic inch of active material.

He had during the last few years examined the data of a very large number of machines to ascertain the values of their constants, and in particular, of the three factors referred to, which he might call the factors of specific utilisation of materials. It was here that the manufacturer was face to face with the possibilities of making the highest possible use of the materials at his disposal. By the adoption of toothed cores, which he had advocated for twenty-five years, the use of higher peripheral speeds had been made possible. The change in design in continuous current generators from the early bi-polar and multi-polar types, to those of more recent date, as exemplified in the Berlin stations illustrated this attainment of higher specific utilisation by higher peripheral speeds, and a type of armature more nearly approaching a flywheel in design. It was clear also that specific utilisation was augmented by using high densities of magnetism in the teeth, and on the other hand it was augmented by using high current densities in the copper. In this connection it must not be forgotten that the losses due to iron were practically a constant at all loads, while the losses due to copper resistance were distinctly load losses.

THE PROBLEM OF EFFICIENCY.

He came then to the question of efficiency, the ratio of output to input. It was generally recognised by engineers that the efficiency was a maximum at the point where the load losses and the no-load losses were equal. The adoption of high densities in the copper for machines that were not always working at their rated maximum load was justified. These considerations had been directed to the utilisation of materials in the active belt, which, of course, was only a fraction of the whole material of the machine. It would appear that in continuous current generators the iron in the belt was from 23 to 32 per cent. of the armature iron, and the copper in the belt from 33 to 43 per cent. of the armature copper. In large alternators the armature copper was about one-fourth that of the copper on the field magnets, and as the active portion was usually only some 40 per cent. of the whole armature copper it followed that the inactive copper on such machines was some eight to ten times as great as the [illegible] copper. Clearly it was not advisable to push the sole consideration of the active belt too far, nor to forget that many of the points as to increased specific utilisation were equally applicable to the inactive part. The influence of the copper space factor and the advantage of using square wire instead of round applied equally to the winding of field magnets.

ADVANTAGE OF HIGH PERIPHERAL SPEED

One broad fact stood out above all these considerations, the advantage gained by the adoption of a high peripheral speed. The last few years had witnesed a very important development in the processes of designing by the discovery and use of certain rational formulæ which, while based on first principles and therefore true for all classes of machines for all different makers, contained certain co-efficients the value of which was determined by experience. The advantage of such rational formulæ was obvious enough. Taking as a basis for experiment a few machines which had been found to work well, and deducing from their dimensions and performance the values of the constants, these same constants could be used to design other machines at different outputs and speeds with the absolute certainty that when constructed their performance would be such as to fulfil the prescribed specification. The output formulæ gave a direct means of starting proper dimensions, and if they did not form an immediate solution to the question of the cheapest machine, they furnished the designer with a number of prima facie designs, each of which would fulfil the specification, and from which he could select the one which under the conditions would be the cheapest to construct. Different formulæ required to be used, the one more suitable for designing continuous current generators being the D 2L formulæ, while the D.L. formulæ was preferable for alternators. It was clear that in the case of continuous current designs the dominant question was sparkless commutation, whereas in alternators regulation was the predominant question, and the surface speed, a secondary consideration in the case of continuous current machines, was of great importance. The lecturer quoted examples to contrast designs respectively appropriate to high and low speeds. These showed the direct and indirect advantages of high peripheral velocity very clearly. The examples quoted were not, however, the product of steam turbine factors. In his next lecture he proposed therefore to trace how the principles thus followed out were extended [illegible] application to steam turbines.

NAVAL NOTES.

The Admiralty announces that His Majesty the King, accompanied by the Queen, will proceed to Portsmouth on February 9th, and sleep on board the *Victoria and Albert*, in order to be present at the launch of *H.M.S. Dreadnought* on the 10th.

The terrible fate of the Brazilian warship *Aquidaban*, which sank near Rio de Janeiro on Sunday night within three minutes of an explosion in the powder magazine, was rendered more disastrous by reason of the fact that she carried more than her usual complement of 388, and that among the passengers were a number of naval officers, government officials, and others, who were engaged in a tour of inspection of sites for the construction of a naval yard. The *Aquidaban* was built at Poplar twenty years ago, and has had a somewhat chequered career. She played a conspicuous part in the revolt of the Brazilian fleet in the autumn of 1893, and in the following March was torpedoed by the *Sampaio* and sunk off Desterro in shallow water, being subsequently raised and fitted out anew at Stettin. For a time she was known as the *Vinte-quatro de Maio*. The *Aquidaban* was a steel sheathed and coppered vessel propelled by two screws. Her length was 280 ft., beam 52 ft., maximum draught 20½ ft., and displacement 4,950 tons. The armament consisted of four 8 in. guns, four 4·7 and eighteen smaller guns, with five torpedo tubes, two submerged forward. She carried a protective belt, varying in thickness from 7 to 11 in., while the two turrets in échelon carrying the big guns were protected with 10 in. compound armour. Steam was supplied by eight cylindrical boilers, supplying two sets of three-cylinder engines, and her speed is given as 10 knots. Her coal capacity was 800 tons.

The new first-class armoured cruiser *Black Prince* has completed her steam trials with the following results:—On the second 30 hours' trial the engines developed 16,699 i.h.p., and the mean speed during the whole of the 30 hours was 21·6 knots. On the 8 hours' full-power trial, which was made off Plymouth on the 12th ult., the engines developed 23,939 i.h.p., giving a mean speed on the measured mile of 23·66 knots. There was a marked absence of vibration and the ship proved to be very steady in a seaway.

At the end of March Rear-Admiral Charles James Barlow, D.S.O., is to succeed Vice-Admiral William Hannam Henderson as Admiral Superintendent of Devonport Dockyard.

It is stated that one of the aspirations of the Labour party is to ease taxation by arriving at some sort of international agreement whereby no more British battleships should be built for several years. It appears to have been overlooked by these orators that the destruction of the Russian fleet has already changed the whole naval situation, and that the Admiralty have consequently been able to reconsider their position. It is an open secret, according to one authority, that the construction of one of the four armoured cruisers authorised by Parliament last spring is to be postponed. This step, following as it does the reduction of the 1904 programme, is surely a very marked step in the direction desired, but, party politics apart, it seems a short-sighted policy to discuss taxation and the navy in the same breath. A strong navy we *must* have. Its curtailment can only be effected after the most grave consideration has been given to the question of expediency, apart altogether from the state of taxation.

SHIPBUILDING NOTES.

On Monday the new steamer [illegible] by the Sunderland Shipbuilding Company, Ltd., proceeded on her official loaded trial. The principal dimensions are :—240 ft. length between perpendiculars, 34 ft. broad, and 16 ft. 8 in. deep, having raised quarter deck, bridge and top-gallant forecastle, built to highest class at Bureau Veritas, special survey. The vessel carries 1,700 tons deadweight, and has cellular bottom and peak tanks for water ballast, four steam winches, steam steering gear, and direct steam windlass. The main engines are by the North Eastern Marine Engineering Company, Ltd., Sunderland, and have cylinders 18½ in., 31 in., and 51 in. by 36 in. stroke, steam being supplied by two large boilers working at a pressure of 180 lb. per square inch. Several runs were made over the measured mile, when a mean speed of 10½ knots per hour was obtained.

Messrs. Workman, Clark and Co., Ltd., of Belfast, launched recently the *City of Glasgow*, a vessel of about 6,400 tons, intended for the passenger and cargo service of the City Line (one of the Ellerman fleets) between Liverpool and Calcutta. The holds have been specially arranged for the reception of bulky cargo, such as locomotives and railway plant, and the latest facilities for rapid loading and clearing of a large and general cargo will be provided. The machinery and boilers, which have been constructed by Messrs. Workman, Clark and Co., consists of a set of quadruple-expansion engines, and supplied with steam from three steel single-ended boilers of the multitubular type, working under Howden's system of forced draught. The construction of the hull and machinery is being carried out under the survey of the British Corporation of Shipping to quality for their highest class, and Board of Trade requirements for a passenger steamer will also be complied with.

The third of the four steamers which Messrs. Harland and Wolff have had in hand for Messrs. T. and J. Brocklebank's Liverpool-Calcutta service, the *Manipur*, left the harbour last week after receiving her finishing touches from the builders. This ship is identical with the other vessels, 414 ft. 2 in. long, 56 ft. broad, 36 ft. 3 in. deep, almost 8,000 tons [illegible]ster and with [illegible] tons, rendering her and sister ships the largest cargo steamers in the Calcutta trade. The machinery, constructed by Messrs. Harland and Wolff at their Abercorn Basin Works, is of the direct acting surface-condensing quadruple expansion type, designed so that at the full load a speed of 12 knots will be maintained at sea on a moderate consumption of coal. Single screws have been adopted, this mode of propulsion being considered the better fitted to meet the special conditions of the service the vessels engage in. The *Manipur* has been built to Lloyd's special survey to class 100 A1 on the three deck rule. The arrangements generally are similar to the steamers already finished, the *Mahronda* and *Malakand*, which we have already described.

Messrs. William Gray and Co., Ltd., launched on the 11th inst. a steel-screw steamer, *Monaro*, which they have built to the order of the Melbourne Steamship Company, Ltd., Melbourne. The vessel will take the highest class in Lloyd's and her dimensions are, length overall 317 ft., breadth 45 ft., and depth 22 ft. 5½ in. The hull is built with deep bulb-angle frames, a cellular double bottom and large after peak tank for water ballast, large hatchways, eight steam winches, steam steering gear amidships, hand screw gear aft, large horizontal multitubular donkey boiler, patent direct steam windlass, steel lifeboats and stockless anchors. The Central Marine Engine Works of the builders supply their type of triple expansion engines of over 1,000 h.p. having cylinders 22 in., 35 in. and 59 in. diameter, with a piston stroke of 39 in. and two large steel boilers to work at a pressure of 180 lbs. per square inch.

A fast passenger steamer, which is being built to the order of Messrs. Fraissinet and Co., of Marseilles, was launched recently from the Neptune Yard of Messrs. Swan, Hunter, and Wigham Richardson, Ltd. The vessel is 273 ft. in length, by 34½ ft. beam. She will be propelled by four-crank triple expansion engines on the Yarrow Schlick and Tweedy system, which together with the boilers, are being built by Swan Hunter, and Wigham Richardson, Ltd., and are [illegible] knots per hour. [illegible] named [illegible]

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts

CONTRACTS OPEN.

	Last Day
London, N.—Roadwork and platelaying for the reconstruction for electrical traction on the conduit system of the first portion of the Council's (northern) tramways, comprising the routes from Bloomsbury to Poplar, and in Kingsland-road, from Old-street to Stamford Hill, together with short terminal lines in connection therewith, for the London County Council. Clerk to London County Council, Spring Gardens, S.W.	Jan. 30
Kilmarnock.—Excavation, concrete work, steelwork, timber work, and other contingent works in forming railway into Riverbank gas and electricity works, for the Kilmarnock Corporation. Mr. Chas. Fairweather, joint engineer, Corporation Gas Offices, Kilmarnock	Jan. 30
Culham (Oxon).—Reconstruction of a portion of Nuneham viaduct over the River Thames, near Culham Station, for the Great Western Railway Company. The Engineer at Paddington Station ...	Jan. 30
Stoke-upon-Trent.—Supply and delivery of meters and demand indicators during year ending March 31, 1907, for the Electricity Committee. Mr. P. J. S. Tiddeman, borough electrical engineer, Electricity Works, Stoke-upon-Trent ...	Jan. 31
London.—For the following plant and materials for the Battersea Borough Council: (1) one set either 750-850-k.w. or 1,000-k.w. direct-current 460 to 550 volts steam generator, piping, and ejector condenser; (2) arc lamp columns; (3) arc lamps; (4) arc lamp globes. The Chief Engineer, Electricity Department, Lombard Road, Battersea	Feb. 5
Wolverhampton. — The Corporation invite tenders for the manufacture, delivery, and erection of an aerial ropeway, approximately 1,300 yards in length, and other works incidental thereto. Mr. E. A. B. Woodward, waterworks engineer, Town Hall, Wolverhampton. ...	Feb. 5
Sparkhill (Birmingham). — Provision and construction of the following approximate lengths of surface-water sewers, for the Yardley Rural District Council—viz.: 902 yds. of 24-in., 130 yds, of 21-in., 260 yds. of 18-in., 231 yds, of 15-in., 103 yds. of 12-in., and 480 yds. of 9-in. pipe sewer; also of the following approximate lengths of foul-water sewers: 480 yds. of 15-in. and 233 yds. of 12-in. pipe sewer—together with manholes, lampholes, flushing shafts, and other works appertaining thereto. Mr. Arthur W. Smith, Council House, Sparkhill	Feb. 7
Hull.—The following for the Town Council (1) supply of air-space telephone cable; and (2) extension to existing multiple switchboard. Mr. A. R. Bennett, Queen Anne's-chambers, Dean Farrar Street, Westminster, London, S.W. ...	Feb. 12
Glasgow.—Electrical cable and conductor installation for Clydebank Dock, for the Trustees of the Clyde Navigation. Mr. Geo. H. Baxter, mechanical engineer, 16, Robertson Street, Glasgow	Feb. 12
Pontypridd. — Supply, delivery, and erection of one 300-k.w. steam dynamo, for the Pontypridd Urban District Council. Mr. J. Colenso Jones, clerk, District Council Offices, Pontypridd ...	Feb. 13
Arkley (Herts).—Covered service reservoir capable of holding about two million gallons, to be constructed on the company's land at Arkley, Hertfordshire, for the Barnet District Gas and Water Company. Mr. T. H. Martin, A.M.Inst. C.E., engineer and manager, Station Road, New Barnet	Feb. 27

COMING CONTRACTS.

Bradford.—An enquiry has been held into an application by the Corporation to borrow £60,000 for purposes of electric lighting.

Birstal.—Local Government Board sanction has been received by the Urban District council to the borrowing of £2,000 for electrical purposes.

Hull.—The scheme for erecting a pier at a cost of a quarter of a million sterling has been discussed at a largely attended town's meeting.

Dover.—The proposal to construct a viaduct road in connection with the harbour improvements at a cost of £42,000 has been approved at a public meeting.

Swansea.—It is proposed to borrow £7,000 for further telephone works.

Dundee.—The electricity committee have approved a scheme of extension which entails an expenditure of £75,000.

Ilkeston.—The Ilkeston sewage scheme is now settled so far as the Council are concerned. The cost is to be £23,000, exclusive of land purchase, engineers' fees, etc., which will bring the total up to £27,000.

CONTRACTS CLOSED.

East Ham.—The Town Council have accepted the tender of Messrs. Allen Son & Co. for a combination of direct steam driven and electric driven plant.

Gravesend.—The Town Council has accepted the tender, at £1,678, of Mr. W. E. Thomas, for additions to the engine house of the generating station.

Manchester.—The Lancashire Dynamo and Motor Company, Limited, of Trafford Park, Manchester, have recently secured orders as follows—Llandrindod Wells Electric Light and Power Company, one 350 kw. generator for direct coupling to Howden engine; Southport Corporation, one automatic, reversible, motor-driven booster and switchboard; Pontypridd Corporation, per Tudor Accumulator Company, one automatic reversible booster, three-wire, for traction and lighting.

London.—The Brush Electrical Engineering Company have received the following contracts:—Liverpool parish, 3-85 k.w. steam dynamos for workhouse installation; and Bermondsey Electricity Works, 500 k.w. steam dynamo.

Leith.—Messrs. Ramage & Ferguson, Ltd., Leith, have received an order from Messrs. George Gibson & Co., Leith, to build a new steamer for their Continental trade, to carry 2,500 tons deadweight and to steam 10 knots loaded.

Calcutta.—The Empire Roller Bearings Company, of Westminster, has secured an order for 320 axle-boxes, to be fitted to 80 heavy goods wagons for Calcutta.

Glamorgan.—The Kennicott Water Softener Company has just received an order for a type "A" Kennicott water softener and purifier, to deal with 15,000 gallons of water per hour, from the Upper Forest and Worcester Steel and Tin-plate Works, Ltd., of Morriston, Glamorgan.

London.—The Pearson Fire Alarm, Ltd., has been authorised by the Fire Offices Committee to connect its system to nearly fifty of the important cities and towns.

Mold.—The Mold Collieries, Ltd., have placed an order with Messrs. Joseph Evans and Sons, of Wolverhampton, for two of their "Griff" pattern suspended steam sinking pumps. Each pump will have a capacity of 750 gallons per minute against a head of 450 ft., with 150 lb. per square inch steam pressure.

London County Council.—The London County Council at its meeting on Tuesday passed the report of the Highways Committee which recommended that the tender of Steel, Peech, and Tozer (Limited), Sheffield, for 2,300 tons of slot rails required in connection with the reconstruction of the first section of the Council's (Northern) Tramways should be accepted. The amount of the tender was £16,055.

Calcutta.—Messrs. Wm. Simons and Co., Ltd., of Renfrew, have received an order from the Calcutta Port Commissioners to supply for the improvement of the River Hoogly a very large Sand suction pump steamer fitted with 4 sets of independent triple expansion engines and 4 large cylindrical boilers to dredge sand at the rate of 5,000 tons per hour. They have also received an order for a powerful combined bucket and pump suction dredger for a foreign Port.

London.—The following contracts have recently been secured by the Worthington Pump Co., Ltd.: Two complete condensing sets for the St. Ouie Railway, Paris, each condenser having 20,000 square feet of cooling surface and pumps. 6,000 square feet condenser and pumps for the Robinson Deep Mining Company. Two complete sets for the Consolidated Goldfields of South Africa, each condenser having 2,500 square feet of cooling surface, with pumps.

APPOINTMENTS VACANT.

Hackney.—The Council require an electrical draughtsman. Salary £130 per annum... ... . Jan. 29.

Swadlincote.—As surveyor and water engineer under the Urban District Council. The salary as surveyor will be £250 per annum, and as water engineer to the Joint Water Committee of Swadlincote and Ashby-de-la-Zouch £40 per annum. Mr. W. A. Musson, clerk, Swadlincote, Ashby-de-la-Zouch ... ... Jan. 31

Birmingham.—The King's Norton and Northfield Urban District Council invite applications for the appointment of first assistant engineer and surveyor to the Council. Salary £180 per annum, rising by biennial increments of £10 to £200. Mr. Edwin Docker, 10, Newhall Street, Birmingham ... ... Feb. 1

Auckland, New Zealand.—Applications are invited for the appointment of City Engineer to the City of Auckland. High Commissioner for New Zealand, Westminster Chambers, 13, Victoria Street, London, S.W. ... ... Feb. 8

East London.—A professor of physics is required at the East London College in succession to Dr. Lehfeldt. Salary £400 per annum .. ... Feb. 5

APPOINTMENTS FILLED.

Birmingham.—Mr. J. P. Kemp, recently representing Sir A. B. W. Kennedy on the Mersey Tunnel contract, has been appointed resident engineer at the Summer Lane Station of Birmingham Corporation. Mr. Frank Forrest, of the Charing Cross, West End and City Electricity Supply Company, has been appointed sub-stations superintendent in the Birmingham electricity supply department.

Dartford.—Mr. J. E. H. Preedy, of Southampton, has been appointed mains engineer at Dartford.

Liverpool.—The Electric Power and Lighting committee recommend the appointment of Mr. Alfred G. Smith, assistant lighting engineer, as gas inspector and superintendent of street lighting, at £400 per annum.

Sheffield.—The Council of the University have appointed Mr. L. T. O'Shea, Professor of Applied Chemistry in the University.

Rome.—Professor Ing. Giovanni Giorgi, M.I.E.E., President of the Associazione Elettrotecnica Italiana, has been appointed chief electrical engineer to the Municipality of Rome.

Cheltenham.—Mr. Robert Long, chief clerk to the Rochdale Corporation Tramways, has received an appointment under the Cheltenham and District Light Railway Co.

Longridge.—Mr. James Marshall has been appointed engineer and surveyor to the Longridge Urban District Council.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows:—
Consols: Feb. 1st General Settlements: Feb. 8th, 22nd: March 9th Bank Rate, September 28th, 1905, 4 per cent.

I.—ENGINEERING, IRON, AND STEEL COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
11,370	5	5	Alldays & Onions Pneumatic Engineering, Ltd.	3	2¾— 3
10,000	5	3/-	Do. Cum. Pref. 6 per cent. ..	5	4¾ — 5
6,210,000	1	1/-	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 3/16 - 3 5/16
76,970	5	2/-	Do. 4% Cum. Pref.. ..	5	5½— 5¾
1,500,000	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	101—103
£100,000	100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt Debs. Red.	100	94 – 97
530,000	1	1/7½	Babcock and Wilcox, Ltd., Ord. ..	1	3¾– 4
100,000	1	7½d.	Do. „ 6% Cum. Pref.	1	1 7/16–1 9/16
20,000	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	5 — 5½
250,000	1	6⅜d.	Baldwins, Ltd., 5½% Cum. Pref. ..	1	1 1/16–1 3/16
£250,000	Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	101–103
150,000	4½	3/	Barrow Hæmatite Steel Co., Ld., O.	4½	5 — 5¼
50,000	4½	3	Do. do. Cum 2nd. Pref.	4½	5 — 5¼
83,334	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾–5¼
£500,000	100	4½%	Beardmore (Wm.) & Co., Ltd. 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	104 104 106
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	12¾ -13¼
£366,600	Stk	4%	Do 4% Deb. Stock, Red.	100	99–101
200,000	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	15/16 – 1 1/16
300,000	1	6⅜d.	Do. 5½% Cum Pref.	1	1 1/16 – 1 3/16 •
£300,000	Stk	4½%	Do. 4½% Red. Deb. Stock	100	91–94
1,629,760	1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	1⅛–1 3/16
1,860,900	1	3¾d.	Do. Nos. 1,639,101-3,500,000	12/-	⅞ – 15/16
1,160,000	1	4½d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1⅜—1½
590,000	1	6d.	Do. Ord., Nos. 1,160,001-1,750,000	1	1⅞—2
74,000	10	5/-	Do. 5% Cum. Pref.	10	11¾—12¼
154,500	5	2/6	Cammell, Laird & Co., Ltd., Ord...	5	10 —10½
232,500	5	2/6	Do. 5% Cum. Pref. ..	5	5½— 5¾
450,000	1	1/2½	Clayton & Shuttleworth, Ltd., Ord.	1	31/32—1 1/32
70,000	5	2/6	Do. 5% Cum. Pref	5	5⅛— 5⅜
£250,000	Stk	4%	Do. 4% 1st Mort. Db. Stk. Red	100	99 -101
100,000	10	30/-	Consett Iron Co., Ltd., Ord.. ..	7½	36½– 37½
57 031	10	10/-	Crossley, Bros., Ld., Ord. 40340/97370	10	15⅛– 15⅜
40,339	10	5%	Do 5% Cum Pref.	10	11½—11¾
75,000	1	2/6	Delta Metal, Ltd. Shares	1	2 — 2¼
1,259,594	1	3¾d.	Dorman, Long & Co., Ltd.	1	15/32 – ½
£400 000	Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk	100	93—96
200,000	5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating..	5	3½— 4
250,000	1	9¾d.	Dunlop (James) & Co., Ltd., Ord...	1	[illegible]
300,000	1	7½d	Do. 6% Cum. Pref. ..	1	[illegible]
4,721	13	13	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	11– 12
69,754	13	10/-	Do. do. do.	10	9½—10
20 250	10	8/-	Elliott's Metal, Ltd.	8	5— 5½
5,000	10	5%	Do. Cum Pref. 5%	10	8½—9½
186,748	Stk	4%	Do. Deb 4%	100	93—95
25,000	10	6/-	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref. ..	10	11½– 12
£250,000	Stk	4½	Do. 4½% Mort. Deb. Stk. Red.	100	100 —103
126,000	3	2/4½	Fraser & Chalmers, Ltd., Ord. ..	3	3¼ 4¼
21,000	3	1/6	Do. 7½% Cum. Pref.	3	5⅜— 5¾
10 000	10	5/-	Galloways, Ltd., 5% Cum. Pref. 18001/28000	10	7¼ 7¾•
£150 000	Stk	4	Do. 4% 1st Mort Deb Red..	100	86 —87•
16,800	10	16/-	Greenwood & Batley, Ltd., Ord. ..	10	6½– 7
9,600	10	7/-	Do. 7% Cum. Pref.	10	10¾ 11¼
965,000	1	1/	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2¼ 2½
844,000	5	2/6	Do. 5% Cum. Pref. .. .	5	6⅛— 6⅜
£1,850,500	Stk	4	Do. 4% Irred. Mort. Deb. Stk	100	105—107
18,000	5	2/6	Gwynnes, Ltd., 5% Cum Pref.	5	2¾ – 3¼
250,000	1	1	Hadfield's Steel F'dry Co., Ld., Ord.	1	3¾– 4
20,000	10	4%	Do. 4% Cum. Pref.	10	10½ - 11
30,000	5	3	Hall (J. & E.), Ltd. 6% Cum. Pref ..	5	4¾ - 5¼
408,505	1	1/-	Harvey United Steel Co., Ltd. ..	1	⅞ – 1
47,500	10	7/-	Hawthorn, Leslie & Co., Ltd. Ord.	10	27 – 29
28,001	5	7/-	Head, Wrightson & Co., Ltd.	5	[illegible]
85,000	1	7½d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	[illegible]
18,000	5	3/-	Do. 6% Cum. Pref.	5	5 – 5¼
£100,000	Stk	6%	Hornsby (Richard) & Sons, Ld., Ord. 6% Cum. Pref.	100	109 110

ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up.	Closing Prices.
750,000	1	6d.	Howard & Bullough, Ltd., Ord. ..	1	1⅜ –1⅝
25,000	10	6/-	Do. 6% Pref. (Non-Cum.) ..	10	12¼—12¾
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	96 —99
37,500	10	20	Kynoch, Ltd.	10	18 —18¼
49,537	10	5%	Do. Cum. Pref. 5% .. .	10	10½—10¾
300,000	1	4½d	Lambert Bros., Ltd., Ord.	1	⅝—⅞
50,000	5	2/9	Do. 5½% Cum. Pref.	5	4 —4½
40,000	3	2/1½	Leeds Forge Co., 7% Cum. Pref. ..	3	4 - 4½
200,000	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	1⅜—1½
£300,000	Stk	4½%	Do 4½% 1st Mt. Deb. Stk., Red.	100	108 —110
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11¾—12¼
210,000	1	8½d.	Measures Bros., Ltd., Ord.	1	1 - 1 1/16
75,000	1	6⅝d.	Do. 5½% Cum. Pref.	1	1 1⅛
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	99 -- 102
21,943	5	2/6	Muntz Metal, Ltd.	5	4¾— 5¼
14,248	5	5%	Do. Pref. 5%	5	4¾— 5¼
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	79 — 82
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	12⅜—12⅞
80,000	5	—	North-Eastern Steel Co., Ltd.,		
£250,000	Stk	4½%	4½% 1st Mrt. Db. Stk., Red.	100	87 — 91
122,000	5	1/6	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	5 — 5¼
50,000	5	3/-	Do. 6% Cum. Pref. "A" ..	5	6 — 6½
70,000	10	10/-	Pease & Partners, Ltd., Ord. ..	10	13¾—14¼
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock ..	100	99—102
20,000	5	3/-	Peebles (Bruce) & Co., Ld., 6% Cm. P.	5	4⅞— 5⅛
65,000	1	—	Pooley (Henry) & Son., Ltd., Ord ..	1	10/6—10/9
13,000	5	—	Do. 5½% Cum. Pref.	5	4⅜— 4⅞
230,000	1	—	Projectile Co. (1902), Ltd., Ord. ..	1	3/16—5/16
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	2 1/16—2 3/16
73,062	5	2/-	Do. New	5	1⅞ — 2
£330,000	—	5%	Do. 5% Mort. Deb., Red. ..	100	100—102
350,000	1	1/2½	Richardsons, Westgarth & Co., Ltd., Ord. 350,001—700,000 ..	1	1—1⅛
£350,000	1	7⅛	Do. 6% Cum. Pref.	1	1 —1⅛
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	100—102
35,000	10	12/-	Ruston, Proctor & Co., Ltd... ..	10	11 —11½
275 000	1	6d.	Scott (Walter) Ltd., Ord.	1	15/32—17/32
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	1 —1 1/16
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk.	100	92 —95
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs.. Red ..	100	92 — 95
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	96 —100
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	1 1/16—1 3/16
300,000	1	1/2½	Do. 6% Cum. Pref...	1	15/16—1 1/16
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	93 — 96
25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10	2¾— 3
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10	5½— 6
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	81— 84
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord. .	10	18¾— 19¼
55,000	10	6/-	Do. 6% Cum. Pref.	10	14½— 15
634,782	1	6d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	⅞ —15/16
538,845	1	6d.	Do. 5% Cum. Pref.	1	15/16—1 1/16
£240,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red	100	96 — 99
300,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	9/16—11/16
£200,000	100	4%	Do. 4% Irredeem. 1st Mort. Deb.	100	80 — 84
£148,500	1	7½d.	Thornycroft (John I.) & Co., Ltd. Or.	1	⅝ — ¾
£160,000	1	7½d.	Do. do. 6% Cum. Pref.	1	⅞ — 1
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum Pf.	10	9 — 9½
$508495200	$100	$½	United States Steel Corp. Com. Stk	$100	46¼ —46½
$360314100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	110—115⅝
$162268000	$1000	5%	Do. 10-60yr. 5% Skg. Fd. G. Bds.	$1000	101—103
3,350,000	1	1/	Vickers, Sons & Maxim, Ltd. Ord..	1	2⅜ – 2½
750,000	1	6d.	Do. 5% Non-Cum. Pref.	1	1 3/16— 1 5/16
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	106	121 —124
£1,250,000	Stk	4%	Do. 4% 1st. Mort. Deb. Stk. Red.	100	104 —106
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs., Red.	100	104 -106
225,000	1	1/2½	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	1⅛— 1¼
500,000	1	7½d	Do. 6% Cum. Pref. Ord. ..	1	1⅛— 1¼
£300,000	Stk	4%	Do. 4% Perpetual Deb. Stock	100	92 — 95
66,666	5	3/-	Willans & Robinson, Ord.	5	2 — 2½
66,666	5	3/-	Do. 6% Cum. Pref.	5	4 — 4½
£246,641	Stk	4%	Do. 4% 1st Mort Deb. Stk. Red	100	82 — 87
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	10	77 —79

Stocks and Shares marked • are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed	Shares	Last Dividend.	Name	Paid up	Closing Prices
70,000	1	6d.	Alliance Elec. Co., Ltd. 5%, Cum. Pf.	1	⅜— ½
125,000	1	7½d.	Aron Elec. Meter Ltd., 6%, Cum. Pf.	1	½— [illegible]
120,000	1	1/2¼	Bell's Asbestos Co., Ltd.	1	1 1/16—1 3/16
£40,000	5	9d	British Aluminium Co. 7% Cum Pref.	5	5½— 6
£300,000	Stk	5%	Do. 5% 1st Mort. Deb. Stk. Rd.	100	[illegible]—101
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	7 — 7½
100,000	5	8/-	Do. 6% Cum. Pref	5	6 — 6¼
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	103 —106
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. ..	100	98 —100
400,000	5	8/-	British Westinghouse Electric and Manufac. Co., Ltd., 8% Pref. ..	5	1¾— 2¼
£616,353	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	77 — 82
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord..	2	½ - ⅝
150,000	2	2/4½	Do. 6%, Pref.	2	1¼— 1½
£125,000	Stk	4½%	Do. 4½% Perp 1st Deb. Stk...	100	99 —101
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	82 — 84
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	11 — 12
40,000	5	2/6	Do. 5% Cum. Pref.	5	5⅝ - [illegible]
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb Stk. Red.	100	108 —110
85,000	3	1/6	Crompton & Co., Ltd...	3	1⅝— 2⅛
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	95 - 98
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	5½— [illegible]
61,000	5	3/-	Do. 6% Cum. Pref.	5	5¾— 6¼
£300,000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	104 —106
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛— 1¼
£233,334	Stk	4%	Do. 1st Mort. 4% free. Deb. Stk.	100	106 —109
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	1⅛— 1⅜
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	2¼— 2¾
£344,023	Stk	4%	Do. 4% Deb. Stock Red. ..	100	86 — 88
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	92— 97
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	[illegible]
31,390	2	2/9¾	Do. 7% Cumulative Pref. ..	2	1⅞— 2⅛
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	90 — 93*
10,248	10	7/6	Evered and Co., Ltd...	10	9 — 11
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9 — 9½
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	96—100
35,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	12½—13½
35,000	5	2/3	Do. 4½% Cum. Pref... .	5	5¼— 5¾
£50,000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	—
50,000	10	15/-	India Rubber Gutta Percha & Telegraph Works Co., Ltd.,	10	18½— 19½
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	99 —102
7,500	10	—	Parker, Thos. Ltd.	10	6½ - 7
100,000	1	3%	Scott (Ernest) & Mountain, Ld., Ord.	1	17/3—17/[illegible]
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	34 - 36
150,000	100	4%	Do. 4% Deb. Bonds	100	100 - 102

III.—ELECTRIC TRACTION.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
120,000	5	3/-	Anglo Argentine Trams Co., Ld., Or.	5	8 3/16 — [illegible]
260,007	5	2/6	Do. 5% Cum Pf.	5	5¾ - 6
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	140 —143
20,000	10	12/-	Barcelona Trams Co., Ltd., Ord. ..	10	13¾ - 14¼
10,000	10	5/-	Do. 5% Cum Pf Shares	10	9½— 10
£46,800	100	5%	Do. 5% Debs., Red. ..	100	98 —101
£191,326	Stk	4½%	Do. 4½% Red Deb. Stk.	100	97 -102
75,606	1	—	Bath Elec. Trams. Ld., Pf. Or. ..	1	[illegible]
59,894	1	6d.	Do. 5% Cum. Pf. ..	1	[illegible]—1 1/16
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1 - 1½
75,000	5	2/6	Do. 5% Cum Pf. ..	5	[illegible]— 4½
£425,000	Stk	4½%	Do. 4½% 1st Deb Stk., Red.	100	94 — 96
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	120—123
		5%	Pref. Ord. Stock	100	110 —113
133,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	8½ - 8¾
156,437	10	6/-	Do. 6% Cum. Pref. ..	10	10 — 11
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	119 — 121
£250,000	Stk	4½%	Do. 4½% 2nd Deb. Stk. Red..	100	98—100
100,000	5	2/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord	5	3⅜—3½
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	[illegible] - 6
27,000	5	3/-	Do. "B" do.	5	[illegible]
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red	100	96 — [illegible]
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds	100	100—104

Stocks and Shares [illegible] * are [illegible]

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares	Last Dividend	Name.	Paid up.	Closing Prices
102,268	5	5/-	Calcutta Tramways Co., Ltd. ..	5	9 —10
£350,000	Stk	4%	Do. 4½% 1st Deb. Stk., Red.	100	104—10[illegible]
480,000	1	6d.	Cape Electric Tramways, Ltd. ..	1	¾ —1⅛
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5% Cum. Pref.	5	4¾ — [illegible]
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	101—104
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red	100	102—104
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13¾—14¼
59,987	10	6/-	Do. 6% Pref.	10	14½—1[illegible]
£125,000	Stk	4½	Hastings & Dist. Elec. Trams. Co., Ltd., 4% Deb Stock, Red ..	100	101 —10[illegible]
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	2¼— 2¾
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	82 — 87
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	9⅝—10
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	98 —101
60,007	1	1/-	London Motor Omnibus Co., Ltd., Ord. No. 1—60,007 . ..	1	1⅜—1⅝
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb. Stock, Red. .. .	100	101 —103
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	[illegible]
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	1 —1 1/16
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	104 -106
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	½— 1½
110,923	8	2/9	North Metropolitan Tramways Co..	8	4 — 4½
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	92 — 97
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	104 —107
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8¾— 9¼
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	9¾— 10¼
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	103 —106
£160,000	Stk	5%	Sunderland Dist. Elec. Trams. Ltd., 5% 1st Mort. Deb. Red... ..	100	92—97
£275,000	Stk	4½%	Yorkshire (W. Riding) Elec. Trams. Co., Ltd., 4½% 1st Deb. Stk., Red.	100	94½ —[illegible]

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
7,500	10	14/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12⅜— 12⅝
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	10¼ —10[illegible]
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11[illegible] — 1[illegible]
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	10[illegible] -107
14,000	5	3/6	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5¼ - [illegible]
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	10[illegible] — 10[illegible]
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	8 — 9
12,433	5	3/3	Do. 7% Cum. Pref. Shares..	5	8 — 9¼
60,000	5	3/3	Calcutta Elec. Sup. Cor. Ltd., Ord..	5	[illegible]
£2[illegible]8,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	10[illegible] —10[illegible]
70,000	5	2/6	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	[illegible] - 6
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	5¼ [illegible]
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	101 —103
1[illegible],436	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.	5	5 — 6
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	108 —110
70,[illegible]95	10	7/-	City of London El. Lghtg. Co., Ld., O.	10	11 —1[illegible]
40,000	10	6/-	Do. 6% Cum. Pref.	10	13¼ - 14¼
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	122 — 1[illegible]
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	100 — 1[illegible]
10,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	[illegible]
30,000	10	6/-	Do. 6% Cum. Pref.	10	12½— 13
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	109 —112
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	5 - 5½
70,000	5	3/-	Do. 6% Cum. Pref. .	5	[illegible]
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	104 — 10[illegible]
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	85 — 90
10,000	5		Folkestone Elec. Supply Co., Ltd., O	5	5¼ [illegible]
£70,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	102 —105
15,000	10	—	Havana Electricity Co., Ltd...	10	8½— [illegible]
15,000	5	5/-	Hove Elec. Lighting Co., Ltd., Ord.	5	[illegible]
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red	100	101— 1[illegible]
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	[illegible]
21,000	5	5/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	18 -1[illegible]

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed	Shares.	Last Dividend	Name	Paid up.	Closing Prices
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	101—103
111,000	3	1 9¾	London Elec. Supply Corp., Ld., Ord.	3	1¾ - 2½
60,000	5	3/-	Do. 6% Pref.	5	4¾ — 5¼
£371,895	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	98 -101
100,000	10	5/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	8¾ — 9¼
76,121	5	2/8	Do. 4½% Cum. Pref.	5	5¼— 5¾
220,000	Stk	4½%	Do. 4½% 1st Mort. Db. Sk., Red.	100	107 —111
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk, Red.	100	95— 97
£250,000	—	4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	100—102½
10,852	10	8/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	13½— 14½
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	98 —100
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6⅜ — 6⅞
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	98 —101*
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —103
40,000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	11½—12½
20,000	5	3/6	Do. 7% Pref...	5	7 — 8
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	97 — 99
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2 — 2½
£50,000	Stk	4%	Do. 4% Debenture Stk Red.	100	76 — 80
65,000	5	4/-	South London Elec. Sup. Co., Ltd. O.	5	8 — 8½
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	¾ — ⅞
50,000	1	8⅖d.	Do. 7% Cum. Pref.	1	1 5/16—1 7/16
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	104 —106
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	4⅝ — 4⅞
30,000	5	2/6	Do. 5% Cum Pref.	5*	5 — 5¼
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red	100	104 106
110,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	10½—11½
28,151	5	2/6	Do. 5% Cum. Pref.	5	——

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed	Shares.	Last Dividend	Name	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	98½—101½
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	3¾— 4¼
£763,580	Stk	14/-	Anglo-American Tel. Co.. Ltd., Ord.	100	65 — 67
£3,118,210	Stk	28/-	Do. 6% Preferred Ordinary	100	113½—114½
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	18½— 18¾
44,000	5	3/-	Chili Telephone Co., Ltd.	5	7⅞ —8⅛*
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	———
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	97½—99½
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8½— 9
6,000	10	10/-	Do. 10% Preference	10	17 —18
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅜ - 3⅝
		5/-	10% Cum. Preference	5	8¼ - 8¾
£30,000	50	4½%	Do. 4½% Debs...	50	99-102½
60,710	20	4/-	Direct U.S. Cable Co., Ltd... ..	20	14½—15½
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	91 —101
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Dbs.	100	101 —103
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	101 -103
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	14½—15*
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	107 - 109
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	147 --150
£2,000,000	Stk	17/6	Do. 3½% Pref.	100	92 —94*
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	107 —109
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	37½—39½
£68,700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	99—101
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	57 —59
£251,127	1		Marconi's Wireless Tel. Co, Ltd. ..	1	1⅛ -1¼
72,680	1	9 d.	Monte Video Telephone Co., Ltd., O.	1	¾ - 1
£1,988,838	Stk	6%	National Telephone Co., Ltd., Pref.	100	112½—113½
£1,966,667	Stk	5%	Do. Deferred	100	110 112
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5⅜ -- 5⅝
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	99½ 101½
£680,598	Stk	4%	Do. 4% do. do. ..	100	104 —106
179,813	1	7½d.	Oriental Telephone & Elec. Co., Ltd.	1	1 5/16 - 1 7/16
50,000	1	7½d.	Do. 6% Cum. Pref.	1	1¼ —1½
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	99 —102
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7¼ - 7¾
58,000	5	3/-	United River Plate Telep. Co., Ltd.	5	7½ - 7¾
40,000	5	2/6	Do. 5% Cum. Pref. ..	5	5½ — 5¾
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	110 --112
15,609	10	4/-	W. African Telegraph Co., Ltd. ..	10	9½—10
£30,008	2½	—	West Coast of America, Ltd. ..	2½	9/16 11/16
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	99½ 101½

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices
88,321	10	6d.	W. India & Panama Teleg. Co., Ld., Or.	10	⅜-- ⅝
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	8¼— 8¾
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	6½ - 7½
£80,000	100	5%	Do. 5% Deb.	100	106—108
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	14¼ —14¾
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	100 —102
518,945	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	102 -104

VI.—SHIPPING COMPANIES.

Present Amount Subscribed	Shares.	Last Dividend	Name	Paid up	Closing Prices
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	9¼— 9¾
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	100—102
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk.. Red.	100	98 —100
40,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6¼— 6¾
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	——
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98 —100
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	14¼— 14¾
40,000	20	8/-	Do. Nos. 60,001-100,000	10	6½— 7
£464,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	102—104
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1⅝ — 1¾
25,828	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	5¾— 6¼
36,758	8	4/9⅜	Do. Non-Cum. 6% Pref.	8	9 — 9½
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	97 — 99
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	1 — 2
40,000	5	2/9	Do. 5½% Cum. Pref.	5	2¾— 3¼
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86
141,500	10	5/-	Leyland (Fredk.), & Co.. (1900), Ltd., 5% Cum. Pref. ..	10	5½— 6
20,349	10	5/-	Orient Stm. Nav. Co.. Ltd., Pref. Nos. 1-20,349 ..	10	7 7½
£103,100	Stk	4%	Do. 4% Deb. Stk., Red. ..	100	87 - 90
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	127—130
£1,160,000	Stk	19%	Do. do. Deferred ..	100	239—242
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	60	53— 54
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾— 5¼
39,075	5	2/6	Do. "B" Ord...	5	3¾— 4¼
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8¼— 8¾
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	10½ - 11
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	99 —101

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed	Shares.	Last Dividend.	Name	Paid up	Closing Prices
60,000	1	9½d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	1 —1¼
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	117 —122
12,500	10	10/	Oakey (John) and Sons, Ltd., Ord..	10	26 — 28
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,588	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	¼ — ⅜
66,462	1	8·4d.	Do. do. Nos. 1-66,462	1	⅜— ½
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1⅛ -1¼
135,000	1	7½d.	Do. 6% Cum. Pref. ...	1	1⅛ -1¼*

RAILWAY CARRIAGE & WAGON COMPANIES.

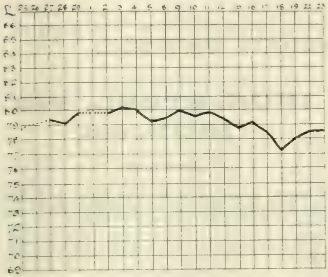
Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up	Closing Prices
10,000	10	7/6	Birm. Railway-Car. & Wagon, L., 1-10,000	10	26 — 26½
8,739	10	3/-	Do. Second Issue 1-8,739....	4	9¾ -10
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13¾ -14¼
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,000	7	10⅜— 10⅝
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 7/16 — 4 11/16
14,567	10	1/8	Lancashire Wagon, Ord.	2	2¼ 2¾
4,150	10	5%	Do. do.	10	10⅜ — 10⅝
784,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	44/6 —45/6
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	24/ —25/-
235,000	1	7½d.	Do. Cum. B Pref. 6% 1-235,000	1	28/9 —29/3
20,000	20	20/-	Midland Rail.-Car & Wagon, Ld., 1-20,000	10	20¾— 21¼

Stocks and Shares marked * are quoted ex-dividend.

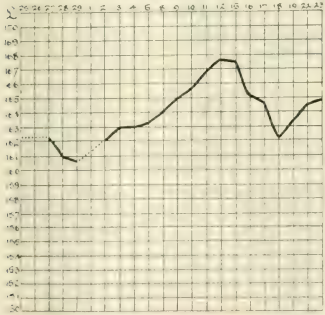
THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM DECEMBER 26TH, 1905, TO JANUARY 23RD, 1906.

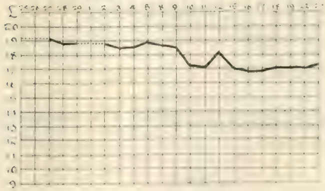
COPPER.



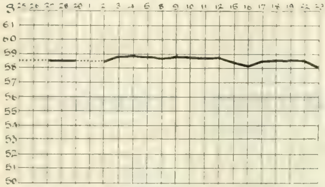
TIN.



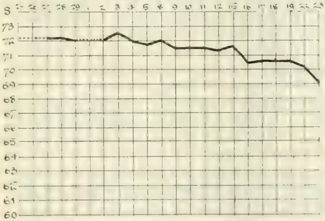
ENGLISH LEAD.



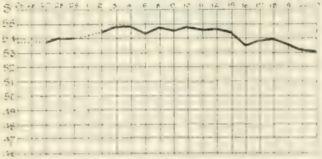
PIG IRON: SCOTCH.



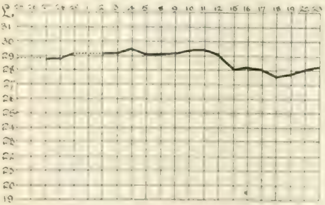
HEMATITE.



CLEVELAND.



SPELTER.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, January 24th, 1906.

THERE is still no sign of a slackening in the demand for copper, and although the higher range of quotations has stimulated production, the increase is by no means proportional to the immediate requirements of consumers, and there can be little room for doubt that consumers' stocks of copper have been allowed to sink to a very low level. Other influences than these have produced some weakness in the speculative market, a bear raid having at one time caused a set-back to £74 for forward metal. At this quotation, good support was, however, forthcoming, and the market firmed up, closing to-day at £78 12s. 6d. cash and £76 17s. 6d. three months.

Tin has been less active; quotations were unsettled by wide variations in the Straits exchange, which enabled importers to reduce their prices. These heavy sales are of course a usual feature in advance of a Banca sale, and the large offerings made saw spot tin down to £161 5s. There has, however, been a sharp recovery, and the closing quotations for to-day are £165 10s. for all positions.

Lead has also been a somewhat dull market, and in sympathy with the tone in other metals the price relapsed, soft foreign prompt being done at £16 8s. 9d. The latest tendency, with a better demand from consumers, has been towards a hardening of prices, soft foreign having recovered to £16 16s. 3d., with English quoted at £17 2s. 6d.

Spelter has had a sharp fall on the realisation of speculative holders, but as producers had sold their output well ahead, they declined to follow the fall in the market, with the result that a recovery ensued, and G.O.B.'s are again quoted at over £28.

According to Messrs. Merton's annual statistics the world's spelter production in 1905 was 647,585 tons, against 615,290 tons in 1904, and 562,325 tons in 1903, or an increase of slightly more than 5 per cent.

The Iron market has been flat on the liquidation of large bull accounts and a sharp fall in Clevelands to 53s. 4d. was recorded, but as in other markets there has been a recovery from the lowest. A noticeable feature has been the demand for standard iron and reports from all trading centres reveal the growing prosperity of the iron trade.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal:—

	Steel:	£	s.	d.
DALZELL	Siemens' Steel Plates, Marine Boiler Quality ..	8	2	6
	,, ,, ,, Land ,, ,, ...	8	2	6
STEEL	,, Steel Bars, Boiler Quality	8	5	0
DALZELL	Siemens' Steel Plates, Ship Quality Plates......	7	2	6
	,, ,, Bars ,, ,, ...	7	15	0
STEEL	,, ,, Angles.........	6	15	0

Manufactured Iron:

	£	s.	d.
Bars—Dalzell	7	2	6
,, Best	7	12	6
,, ,, Horseshoe	7	12	6
,, Angle..	7	2	6
,, Best Angle	7	12	6
,, Best Best	8	2	6
,, Extra Best	8	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

Malleable Common Bars:	£	s.	d.	
Dalzell, per ton	7	2	6	5 per cent
Govan	6	10	0	,,
North British	6	10	0	,,
Drumpellier	6	7	6	,,
Waverley	6	10	0	,,
Crown	6	5	0	,,
Dundyvan	6	5	0	,,
Muirkirk	6	5	0	,,
Rochsolloch	6	5	0	,,
Phœnix	7	5	0	,,
Coatbridge	7	2	6	,,
Coats	6	5	0	,,
Angle Iron				,,
Steel Plates, ship				,,
,, Boiler Plates				,,
Rails..				,,
Railway Chairs		—		,,

G.M.B. at Glasgow, No. 1, 64s.; No. 3, 61s.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quote:—

	£	s.	d
Bars—Phœnix	7	5	0
,, Best	7	15	0
,, Best Best	8	5	0
,, Extra Best	8	15	0
,, Best Horse Shoe	7	15	0
,, Extra B.H.S.	8	15	0
,, Extra Best Cable	9	5	0
,, Rivet	7	5	0
,, Best Scrap Rivet	8	5	0

	£	s.	d.
Angles—Phœnix	7	5	0
,, Best	7	15	0
,, Extra Best	8	5	0
Gas Tube Hoops—Phœnix Best	7	15	0
Plates—Phœnix	—		
,, Best Boiler	8	10	0
,, Best Best Boiler	9	0	0
,, Extra Best Boiler	10	0	0
Boiler Tube Strips—Phœnix	9	0	0

All per ton, delivered f.a.s. Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote (Commission extra).

Pig Iron:	No. 1. £	s.	d.	No 3. £	s.	d.
Coltness, f.a.s. Glasgow	3	16	0	3	6	0
Gartsherrie ,,	3	8	6	3	3	6
Summerlee ,,	3	11	0	3	6	0
Carnbroe ,,	3	5	6	3	2	6
Langloan ,,	3	10	0	3	5	0
Calder ,,	3	7	6	3	2	6
Clyde ,,	3	8	0	3	3	0
Glengarnock, f.o.b. Ardrossan	3	8	0	3	3	0
Eglinton ,, ,,	3	3	6	3	1	0
Dalmellington, ,, Ayr	3	6	0	3	1	0
Shotts ,, Leith	3	7	6	3	2	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works**:—

	£	s.	d.
W.W. ♔ Bars	7	10	0
W.W. Best Bars	7	17	6
W.W. Best Best	8	5	0
W.W. Best Best Best	8	12	6
W.W. Best Shoe	8	0	0
Thornaby ♔	9	0	0
Thornaby Best	9	10	0
Thornaby Best Best	10	10	0
Whitwell Special Admiralty Cable	11	0	0
Special Chain Iron	10	0	0
Tube and Nail Strip iron net cash	7	10	0
W.W. ♔ Angle Iron	7	12	6
W.W. Best Angle Iron	8	0	0
Tee Iron, to 8-inches United	8	10	0

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd., Dallam and Bewsey Forges, Warrington, quote as follows:—

		Iron. £	s	d.	Steel £	s.	d.
♔	Bars	7	15	0	8	0	0
	Angles	8	5	0	8	10	0
(BN)	Tees	8	15	0	9	0	0
♔	Hoops	8	0	0	8	0	0
W.I.W	Sheets	9	0	0	9	5	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.

Extras for Sizes and Cutting as per List

Lots under 10 cwts. of a size 10s. per ton extra.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets	Singles 20 G 96 in. by 36in. per ton. £	s	d	Doubles 21 G to 24 G 96in. by 36in. per ton. £	s	d.
"Vale"	11	0	0	12	0	0
"Shield"	11	10	0	12	10	0
"Severn"	12	10	0	13	10	0
"Baldwin Wilden B."	13	10	0	14	10	0
Charcoal	17	10	0	18	10	0
Best Charcoal	19	10	0	20	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:	£	s.	d	£	s.	d.
No. 3 Lead	14	10	0	15	10	0
S.V. Lead	16	0	0	17	0	0
No. 3 Terne	16	0	0	17	0	0
S.V. Terne	17	10	0	18	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton. £	s.	d.	Doubles 21 to 24 G to 96 by 36in. per ton. £	s.	d
Best Coke (Finish)	30	0	0	31	10	0
,, Charcoal (Finish)	32	0	0	33	10	0
Extra ,, ,,	34	0	0	35	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	13	7	6	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	16	5	0	,,

Galvanized Working Up-Sheets:

	£	s.	d	
24 G., f.o.b. London, in Bundles	14	7	6	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d	
Crown Bars	7	10	0	per ton.
Best Bars (1 to 6in. wide, above ¼ in. thick, ½ to 4 in. rounds and squares)	8	0	0	,,
Angles	7	15	0	,,
,, Best	8	5	0	,,
T's	8	0	0	,,
,, Best	8	10	0	,,
Best Shoe Iron	8	0	0	,,
,, Rivet Iron	9	0	0	,,
,, Best Rivet (Special)	10	5	0	,,
,, Cable	10	5	0	,,
,, Screwing	9	5	0	

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	9	5	0	,,
Best Best	10	5	0	,,
Treble Best	11	5	0	,,
Plates	8	10	0	,,
Best Plates	9	0	0	,,
,, Boiler Plates	9	10	0	,,
,, Best Boiler Plates	10	10	0	,,
Treble Best Boiler Plates	13	0	0	,,

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails steel nails, &c.

Discounts—

42½ per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

37½ per cent. off 3½-inch to 7-inch strong rose and 10dy. and 20dy. pound.

37½ per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 10/6 per cwt.
4 cwt. lots and upwards 10/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch to 6-inch basis—

2 tons 9/3 per cwt.
4 cwt. lots 9/6 per cwt. } d/d any Railway Station.

Slit rods (iron) £8 per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E.C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote:—

	Per Box. f.o.b. Wales. £	s.	d.
Coke Tin-plates.			
C 18¾ by 14 124s. 110 lb. "BV"	0	13	6
C 20 by 10 225s. 155 ,, "Jumbo"	0	18	9
C 20 by 14 112s. 108 ,, "Lydbrook"	0	13	3
C 28 by 20 112s. 216 ,, "Lydbrook"	1	6	9
Charcoal Tinplates:			
C 20 by 14 112s. 108 lb. "Allaway"	0	14	0

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

		£	s.	d.	
Steel:					
Blooms	at	4	8	0	per ton.
Billets	at	4	10	0	,,
Sheet Bars	at	4	12	0	,,
Finished Steel:					
Bars	at	6	0	0	per ton.
Angles	at	6	2	0	,,
Tees	at	6	4	0	,,
Joists	at	5	5	0	,,
Fencing Standards	at	6	7	6	,,
Shoeing Bars	at	6	5	0	,,
Tyre Bars	at	6	5	0	,,
Half-Round Bars	at	6	10	0	,,
Heavy Rails	at	6	0	0	,,
Light Rails	at	6	0	0	,,

tructural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1¼% & 1%	166	10	0	to	167	0	0	per ton
English Bars, f.o.b. Dis. 1¼% & 1%	167	10	0	to	168	0	0	,,
Straits G.M.B., cash Warehouse, Net	164	17	6	to	165	0	0	,,
Straits G.M.B., 3 months, Warehouse, Net	164	17	6	to	165	0	0	,,
Australian, Mt. Bischoff, Warehouse, Net	166	0	0	to	166	5	0	,,

COPPER.

Copper:	£	s.	d.		£	s	d	
Standard G.M.B., cash Warehouse, Net	78	5	0	to	78	10	0	per ton.
Standard G.M.B., 3 months, Warehouse, Net	76	7	6	to	76	10	0	,,
English, Tough, Cake & Ingot, Warehouses, Net	84	0	0	to	84	10	0	,,
English, Best Select, Warehouse Net	84	0	0	to	84	10	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	92	0	0	to	93	0	0	,,
English, Sheets for India, f.o.b., Dis. 2½%	89	0	0	to	90	0	0	,,
Electro, Warehouse, Net	86	5	0	to	86	10	0	,,
Ore, ex. ship	0	15	6	to	0	16	6	per unit.
Regulus, Matte and Precipitate, ex ship,	0	16	6	to	0	17	0	,,

YELLOW METAL.

Yellow Metal:	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%	0	0	7½	per lb
Sheathing ,, ,,	0	0	7¼	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	28	2	6	to	28	5	0	per ton.
Blende of 50 %, Net	8	10	0	to	8	13	6	,,
Calamine, Net	8	12	6	to	8	15	0	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis 2½%	17	0	0	to	17	5	0	per ton.
Spanish, ex ship, Dis. 2½%	16	16	3	to	16	17	6	,,
Lead Ore of 70 %, Net	9	0	0	to	9	10	0	,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½ %	65	0	0	to	66	0	0	per ton.
Ore, 50 %, ex ship, Dis. 2½%	16	0	0	to	17	0	0	,,
Crude, ex ship, Dis. 2½ %	35	0	0	to	38	0	0	,,

QUICKSILVER.

	£	s.	d	
Spanish, 75 lb., Warehouse, Net	7	7	6	per flask
Italian ,, ,, ,,	7	5	6	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.	s.	d.
Main Coal	6	6
Best Hard Steam (hand picked, as used by the Railway Companies)	5	6
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston, quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	3
Large Nuts (1½ to 3½)	9	0
Small Nuts (¾ to 1½)	6	0
Peas (½ to ¾)	5	0
Rough Slack	4	0
Slack	3	6
Smudge	2	0

Rutland Coal:	s.	d.
Brights (4 to 8)	7	6
Large Nuts (2 to 4)	7	0
Slack	3	6
Hand-picked Hards	7	6
Hard Cobbles	6	3

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	8

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit :—

Digby Coal:

STEAM:	s	d
Best Hand Picked Hard	8	6
Steam Hard	7	3
Hard Nuts	6	6

Gedling Colliery.

HIGH HAZEL (or Ashless House Coal).		
London Brights, 4 to 8 in cube	11	0
Bright Cobbles (Hand Picked)	10	6
Large Nuts, 2 to 4 in cube	10	0
Small Nuts, 1 to 2 in cube	6	3
Pea Nuts, ½ to 1 in cube	5	0
STEAM — TOP HARD.		
Best Hard	8	6
Hard Steam	7	6
Cobbles	6	8

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

		£	s.	d.	
Acids:	Oxalic	0	0	2½	per lb
	Picric, Crystals	0	0	11	,,
	Tartaric ... at Manchester	0	0	11	,,

		£	s.	d.	
Acetate of Lime:	Brown at Manchester net	8	10	0	per ton.
	Grey ,,	11	15	0	,,
Alumina:	Alum, Lump, loose	5	7	6	,,
	,, ,, in casks	5	10	0	,,
	,, Ground, in bags	5	17	6	,,
	Sulphate of Alumina, 14%	4	10	0	,,
Ammonia:	Carbonate	0	0	3¾	per lb.
	Muriate Grey f.o.b. Liverpool	24	15	0	per ton.
	Sal-ammoniac, Lump, 1sts, del^d. U.K.	42	0	0	,,
	,, ,, 2nds, ,,	40	0	0	,,
	Sulphate f.o.b. Liverpool	12	18	0	,,
Arsenic:	Best White Powdered net	16	10	0	,,
Bleaching Powder,	35% ,,	4	10	0	,,
Borax:	British Refined Crystal ,,	13	0	0	,,

Coal Tar Products:				
Benzole, 50/90 % ,,	0	0	8½	per gal
,, 90% ,,	0	0	9	,,
Carbolic Acid Crystals, 34/35° C. ,,	0	0	6	per lb
,, ,, ,, 39/40° C. ,,	0	0	6¼	,,
,, ,, Liquid, 97/99 % ,,	0	0	9	per gal
,, ,, Crude, 62½ % at 60° F. f.o.b. ,,	0	1	10	,,
Creosote, ordinary good liquid ,,	0	0	1¾	,,
Naphtha, Crude, 20 % at 120° C. ,,	0	0	4	,,
,, Solvent, 90% at 160° C. f.o.b ,,	0	1	0	,,
,, ,, 95 % at 160° C. ,, ,,	0	1	0½	,,
,, ,, 90 % at 190° C. ,, ,,	0	1	1½	,,
,, Rectified, flash point over 73° F. f.o.b. ,,	0	1	1½	,,
,, Rectified, flash point over 100° F. f.o.b. ,,	0	1	2½	,,
Naphthalene, all qualities				
Pitch f.a.s. Manchester. ,,	1	11	6	per ton.

Copperas:	Green, in bulk ,,	0	12	6	,,
	,, barrels f.o.b. L'pool ,,	1	18	6	,,
	Cake ,,	1	1	6	,,
Copper:	Sulphate	25	0	0	,,
Cyanides:	98% minimum f.o.b. net	0	0	8½	per lb.
Lead:	Acetate (Sugar) White, English	28	0	0	per ton.
	,, ,, ,, Foreign c.i.f. U.K	25	10	0	,,
	,, ,, Grey	23	10	0	,,
	,, ,, Brown at Manchester	19	15	0	,,
	Nitrate	27	0	0	,,
	Litharge, Flake	19	5	0	,,
	,, Powder	19	15	0	,,
	Red Lead, Genuine, c.i.f London less 5%	19	5	0	,,
	White ,, ,, Dry ,, ,, ,,	20	0	0	,,
Naphtha (Wood):	Miscible, 60 o.p.	0	2	4	per gal
	Solvent	0	2	7	,,
Potash:	Bichromate.. delivered England..	0	0	3	per lb.
	Carbonate, 90/92 % ... c.i.f Hull ...	16	15	0	per ton.
	Caustic, 75/80 % ,, ,,	18	12	6	,,
	Chlorate net	0	0	3¼	per lb
	Montreal ... in Store, Liverpool	31	10	0	per ton.
	Prussiate Yellow net	0	0	4½	per lb.

	£	s.	d.	
Soda: Ash, Caustic, 48 %, Ordinary .. net	5	5	0	per ton.
,, .. ,, Refined ,,	6	5	0	,,
,, Carbonated, 48 % ,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali) net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 % net	6	10	0	,,
Caustic, White, 77 % ,,	10	12	6	,,
,, ,, 70 % ,,	9	12	6	,,
,, ,, 60 % ,,	8	12	6	,,
,, Cream, 60 % ,	8	10	0	,,
Crystals, in bags	3	0	0	,,
,, barrels	3	7	6	,,
Acetate c.i.f. Hull net	16	15	0	,,
Bicarbonate, in 1 cwt. kegs	6	15	0	,,
Bichromate......delivered England...	0	0	$2\frac{1}{4}$	per lb.
Chlorate net	0	0	$3\frac{1}{4}$	per lb
Nitrate...ex quay Liverpool, ... ,,	11	0	0	per ton.
Phosphate	9	5	0	,,
Prussiate net	0	0	$3\frac{7}{16}$	per lb.
Silicate, Solution, 140° Tw.	4	10	0	per ton.
Sulphate (Glauber Salts)	1	10	0	,,
,, (Saltcake, 95%)	1	15	0	,,
Sulphur: Recovered	4	15	0	,,
Roll	6	15	0	,,
Flowers	7	10	0	,,
Zinc: Sulphate	6	15	0	,,
Shellac: Standard TN orange spot	9	10	0	per cwt.

MINERALS.

Messrs. S. W. Royse and Co., quote :—

	£	s.	d.	
Barytes: Lump Carbonate, 90/92%	3	10	0	per ton.
Sulphate, No. 1 White	2	15	0	,,
China Clay: of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore: Basis 50% c.i.f. British Ports	3	10	0	,,
Manganese: Lump c.i.f. Liverpool $10\frac{1}{2}$d.	per metallic unit.			
Ochre: French JC f.o.b. Rouen, net	2	5	0	per ton.
,, JF	5	10	0	,,
Talc: (French Chalk) c.i.f. Liverpool	3	10	0	,,

Messrs. Henry Bath and Son, quote :—

	£	s.	d.		£	s.	d.	
Copper, Ores of, 10 to 25%	0	15	3	to	0	16	3	per unit.
Regulus, 45 to 55%	0	16	3	to	0	16	9	,,
Precipitate, 65 to 80% ...	0	16	$4\frac{1}{2}$	to	0	16	$10\frac{1}{2}$	,,
Tin Ores, 70 %	107	0	0	to	108	0	0	per ton.
Lead Ore, 70%					8	18	0	,,
Blende, 50%					8	3	6	,,
Calamine					8	6	0	,,
Antimony, Star Regulus	63	0	0	to	65	0	0	,,
,, Ore 50%	15	0	0	to	18	0	0	,,

Messrs. Barrington and Holt, Cartagena, quote :—

Iron Ore.

		s.	d.	
Ord. 50%,	f.o.b. Porman	7	8	per ton.
Do.	,, Cartagena	8	0	,,
Special low phos,	,, Porman			
Do. do.	,, Cartagena	8	2	,,
Extra quality do.	,, ,,	8	6	,,
Special Iron Ore	,, ,,	nominal		,,
Specular 58% do.	,,	11	0	,,
S P Campanil Coast	,,	9	6	,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote for wholesale quantities on c.i.f. Liverpool terms :—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	3
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	4		0	3	3
Lower Ports Pine	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	3
Quebec Oak, 1st quality	,,	0	2	9		0	3	4
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	3		0	4	0
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks	,,	0	0	10		0	1	0
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do.	,,	11	10	0		13	0	0
St. John, Miramichi, etc., Spruce	,,	7	15	0		8	0	0
Nova Scotia Spruce	,,	7	12	6		7	17	6
Spruce Boards	,,	6	15	0		7	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s	d		£	s.	d.
Hewn	per cub. ft.	0	1	6	to	0	2	0
Sawn	,,	0	1	6		0	1	10
Planks, Stowage	,,	0	1	0		0	1	2
Boards, Prime	per std.	15	10	0		18	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	9		0	2	1
East India Teak	per load	15	0	0		20	0	0
Greenheart	,,	6	15	0		7	5	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	6	to	0	2	0
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish	,,	0	1	0		0	1	3
Riga Whitewood	,,	0	1	0		0	1	3
Norway Mining Timber	,,	0	0	9		0	1	0
Dantzic and Stettin, etc., Oak	,,	0	2	6		0	3	0
Norway Spars	,,		1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0		20	0	0
Red Archangel and Onega, 2nd quality	,,	14	0	0		16	0	0
Red Archangel and Onega, 3rd quality	,,	10	10	0		12	10	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ,, ...	,,	14	0	0		15	0	0
Gefle	,,	11	10	0		16	0	0
Wyburg	,,	11	0	0		12	10	0
Uleaborg	,,	10	0	0		12	10	0
Gothenburg	.	11	0	0		16	0	0

OPENINGS FOR TRADE ABROAD.

Argentina.

The Rosario [illegible] will be received [illegible] for the [illegible] lighting of that city.

Belgium.

The Belgian State [illegible] will shortly invite tenders in five lots for the supply of [illegible] turntables [illegible] metres diameter [illegible].

Roumania.

There is a project on foot for the lighting by electricity of the town of Focsani, at an estimated cost of £13,920. In Bucharest plans have been prepared for new tramway line, connecting the centre of the town with the Jubilee Exhibition.

Spain.

Consideration is being given to a scheme for the carrying out of irrigation works at Tudela for the purpose of watering [illegible]. To accomplish this it is proposed to raise the waters of the Ebro to [illegible]. The estimated cost of the work is £16[illegible].

British India.

The Southern Mahratta Railway Company, Ltd. are prepared to receive tenders for deck bridges as per specification and drawings which may be seen at the offices of the Company, 46, Queen Anne's Gate, S.W. Tenders must [illegible] not later than noon on Tuesday [illegible].

Cuba.

Mr. G. F. G[illegible] the representative of the Cuban Electric Company, has made formal application for permission to construct a tramway line in Regla, and two tramway lines in Guanabacoa. These lines are to be connected with the tramway between Regla and Guanabacoa.

Australian Commonwealth.

Tenders will [illegible] Supply and Tender Board Office, Adelaide, on Tuesday, 6th prox., for the supply and delivery of 3,755 tons steel rails, 50 lb. per lineal yard, and 242 tons steel fishplates, for 50 lb. rails. The rails and fishplates are to be delivered upon trucks on a railway wharf at Port Pirie, and upon [illegible] duty (if any) will be paid by the South Australian Government. Wharfage to be paid by the contractor. Drawings and specification can be seen, and forms of tender obtained at the Supply and Tender Board Office, and from the Chief Storekeeper, Public Stores, Port Adelaide at 10s. per set.

Spain.

Tenders, which will be opened on February 1st at the Directorate of Public Works, Madrid, are invited for the construction of an iron bridge over the river Canero, on the main road from Villalba to Oviedo, in accordance with plans and conditions on view at the above-named office, and at the office of the Civil Governor of the Province of Oviedo. The estimated cost of the work is about £5,307.

Attention was given in a recent consular report from Madrid to the scarcity of goods wagons on Spanish railways. The mining district of Asturias has suffered considerably on this account, and in order to bring to the notice of the Government the continued hindrances experienced in connection with the Northern railway, the colliery owners there have been considering the question of closing their establishments. Other mining concerns have been obliged to order a large number of wagons on their own account, including a group of Asturian firms who are buying 200 of 20 tons capacity, and, it is added, it is not improbable that other mining companies will similarly order further rolling stock on their own account.

Norway.

The British Vice-Consul at Trondhjem has informed the Board of Trade that tenders are invited for the supply of the following material:—Alternative 1—[illegible] tons [illegible] steel rails of varying lengths, [illegible] tons fishplates, 45 tons dogs (to sketch), 61,600 underlayer plates. Alternative [illegible] tons [illegible] steel rails of varying lengths, 67 tons fishplates, 46 tons dogs (to sketch), 84,000 underlayer plates. The material is to be delivered c.i.f., Thamshavn pr. Trondhjem as follows:—250 tons rails, 27 tons fishplates, 1.68 tons bolts, 0.97 tons (54,000) dogs in June, 1906; one-half of the remainder in March, 1907; and the rest in June, 1907. Tenders are to be addressed "Chr. Salvesen and Chr. Thams's Communications Aktieselskab, [illegible]

ABRIDGED SPECIFICATIONS.

A. Robertson, Little Hulton, near Bolton, and T. Robertson, Daubhill, Bolton—19,535.—In a rotary cutter-wheel machine for mining coal and other minerals, provision is made for cutting at any angle with the horizontal plane. As shown in plan in fig. 7, the cutter-wheel a^1 is carried in the frame A supported on a supplementary frame B. Slots *c*, c^1, fig. 1, are formed in each side of the supplementary frame B and pins *b*, b^1, formed on the frame A slide in them. Upon moving the frame A longitudinally, it is tilted to one side or the other according to the direction, motion being produced by rotating a screw *d*, fig. 7 passing through a pin b^1 and fixed on the frame B; or a screw d^1, mounted in bearings secured to the frame A and working in the nut fixed in the frame B, may be provided. Other means, such as rack-and-pinion mechanism or cams working on transverse shafts, may be adopted. The inclination of the cutter-wheel is shown by a pendulum and graduated dial. The cutter-blades *a*, fig. 10, are made separate from the holder *s* and are fixed by the screws *u*. They can then be hardened with greater safety to the wheel. The frame A is further supported near the cutter-wheel.

FIG. 1.

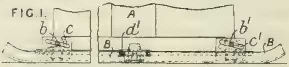
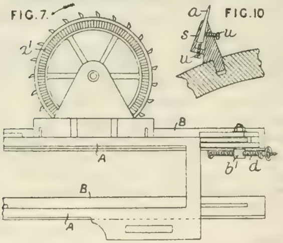


FIG. 7. FIG. 10



British Thomson-Houston Company, London.—(General Electric Company; Schenectady, New York, U.S.A.)—20,809.—Relates to electric furnaces. Resistance furnaces are constructed so that heating may be effected in a vacuum or in any gas. A cylindrical gun-metal box 1, fig. 2, which may be tinned to prevent leakage, is provided with a cover 2 secured to it by bolts 3. A lead washer 4, and grooves in the box and cover, make a tight joint. Through the cover pass U-shaped hollow conductors 6, 7, which support the resistance-body. This consists preferably of a helix of graphite formed from a cylinder by cutting in it a slot terminating at some distance from its ends. The resistance-body is held by a block 8 and by a cup 10, both formed of graphite. The blocks 8, 10 have semi-cylindrical grooves to receive the conductors 6, 7, and are secured to them by copper clamps 11, 12. An emery washer in the bottom of the cup 10 supports a graphite rod 13, which carries the crucible 14 or other object to be heated. Surrounding the resistance-body 5 is an annular box 15 of refractory material, filled with powdered graphite and resting on lava insulating-buttons on copper supports. The conductors are insulated from the cover as shown in fig. 5. A shouldered metal sleeve 23 soldered to the conductor 6 passes through the cover and is secured in place by a nut 25, paper insulation being interposed at 24, 45. A mica washer 26 and two lead washers 27, 28 are placed between the shoulder of the sleeve and the cover 12. The washer 27 has a larger aperture than the washer 28, so as to allow the paper insulation 45 to meet the mica washer 26. A pipe (not shown) leads from the box to an air pump, and has a branch which may be connected to the source of the gas to be introduced. A sight-aperature 31 in the cover is glazed with mica and made airtight by lead washers. The box, which has projecting lugs 39, is immersed in a water jacket, and the conductors 6, 7, are cooled by passing water through them by means of rubber tubes. The furnace may be employed for the reduction of metals from their compounds, the preparation of alloys, and for other purposes.

FIG 5

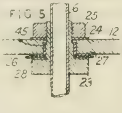
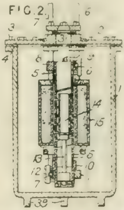
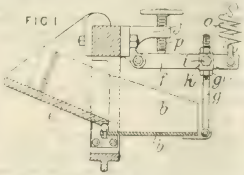


FIG. 2.



Fraser and Chalmers, London.—(Hunter, H. M.; Crown Reef Gold Mining Company, Johannesburg, Transvaal, S.A.)—20,529.—Relates to feeding-devices for ore and like stamps. The ore is delivered by a shoot on to a pivoted tray *b* which delivers it to the mortar box of the mill. The tray is actuated by a link *e* operated by a lever *f*, which is pivoted at one end to the framing *j* and at the other end is struck by the stamp tappet

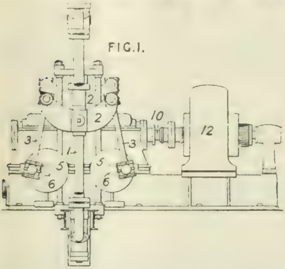
FIG 1



The screwed end of the link g passes through a sleeve h, secured by a pin and nut i to the lever f, and is adjustable by means of nuts [illegible]. The lever f is returned by a spring [illegible] and a set-screw [illegible] limits its movement.

R. Waygood and Co., and R. Carey, London: [illegible].—Relates to driving-gear for high-speed pumps and comprises a shaft [illegible] driven by a motor [illegible] and carrying right and left-handed independent worms gearing with worm-wheels on the shafts 6. The shafts 6 carry crank-discs on their equivalents 5 coupled by connecting-rods 3 to a crosshead 2 attached pivotally by a gudgeon to the pump plunger 1, or rigidly connected to it.

FIG. 1.



E. A. Carolan, London.—General Electric Company; Schenectady, New York, U.S.A.—[illegible].—Relates to electric transformers and rectifiers. Two portions of a tube containing a conducting fluid are placed in magnetic fields, a current is led through one portion to cause the fluid to move, and an induced current is collected from the second portion. A magnet A and armature [illegible] are shown in Fig. [illegible], the magnet being energised by the field coil B and supported by non-magnetic bars D. A number of tubes E, of insulating material or lined with insulating material, are placed in the air gap between the magnet A and armature [illegible]. Each of these tubes is provided with electrodes [illegible] conducting [illegible]. The upper electrodes are connected to terminals f, f at the top of the magnet, Fig. 2, and the lower electrodes to the terminals f^1, f^1. If a potential is impressed upon the terminals [illegible], current flows through the tubes E in a direction at right angles to the field in the air gap, thus producing a movement of the conducting fluid. The fluid cuts the flux at the lower pole of the magnet A, and an electro-motive force is induced, and a current can be led off from the terminals f^1, f^1. The fluid used may be either liquid or gas, or may consist of drops of conducting liquid, separated by drops of insulating liquid or solid insulating substances. The fluid may be replaced by solid balls, alternately conducting and insulating. The electrodes may be connected in series or parallel or series-parallel combinations to secure any desired ratio of transformation, the arrangement shown giving a two to one ratio. Alternating current may be supplied to the terminals f, f, and the top electrodes subjected to an alternating field, securing a unidirectional movement of the fluid. If the lower set of electrodes remains in a constant field, a direct current may be taken from the terminals f^1, f^1. The tubes may be spiral, etc., and voltage transformatio may be obtained from a single tube by subjecting the two sets of electrodes to fields of different strengths.

FIG 1

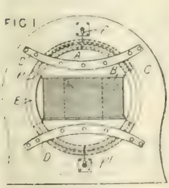


FIG 2.

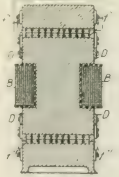
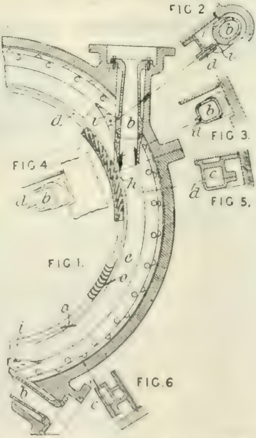


FIG 3

Belliss and Morcom, and A. Jude, Ledsam Street Works, Birmingham.—[illegible].—Relates to steam, etc., turbines. The inlet passage forming a continuation of the expanding nozzle [illegible], comprises a



[illegible] radially [illegible] as shown in Fig. 2 [illegible] the slot [illegible] intervals [illegible] shown.

NEW PUBLICATIONS.

"GAS, OIL AND AIR ENGINES.'

By Bryan Donkin. Fourth edition revised and enlarged. Charles Griffin and Co., Ltd. 25s. net.

Most of our readers are more or less familiar with the late Mr. Bryan Donkin's scholarly treatise, which has now been revised by that writer's secretary. The work is divided into three sections. Opening with a general description of the action and parts of a gas engine, the first section is mainly of an historical nature, dealing with the early developments of these motors. The second part is devoted to modern gas engines. The discovery, utilisation, and properties of oil having been discussed, consideration is given to the methods of treating oil, the working method in oil engines. British, American and Continental oil engines are described, and the section is brought to a close with a chapter on their practical applications. Part three, the concluding chapter, deals briefly with the various types of air engines. Since the publication of the previous edition, there has, of course, been a considerable increase in the size and efficiency of internal combustion engines, and in carrying out his work of revision the editor has included notices of all the latest practice. The tables of trials, which have been brought up to date, contain a number of interesting results. The work, which is amply illustrated, is one that should be in the possession of every mechanical engineer.

"THE PRACTICAL TELEPHONE HANDBOOK"

And Guide to Telephonic Exchange. By Joseph Poole, A.I.E.E. Third edition. Whittaker and Co. 6s. net.

The fact that this handbook, now enlarged so extensively, has reached its third edition, proves conclusively that the work well meets the requirements of those for whom it was designed. The present edition has more than twice the amount of letterpress in the previous edition. But this is easily accounted for when one bears in mind the remarkable growth in the scope of telephony that has come about during the last five years. In general, the writer has confined himself to British practice, and in particular to the National Telephone Company. The instruments he describes are those in actual use, although exceptions are made where some special principle is illustrated in the apparatus details. The first chapter, appropriately enough, is concerned with the fundamentals of electricity, the following sections deal with batteries, receivers in general use, transmitters in practical use, sub-station apparatus and instrument connections, intermediate switches and extension instruments, intercommunication telephones, switch-board apparatus relay and lamp signalling, small switch-boards, larger sub-station and private branch exchange switchboards, multiple switchboards, etc., junction line working, trunk line exchanges, apparatus room, the power plant, aerial and underground work, the Pupin system, localisation of faults, electrical measurements, automatic and special exchange systems and miscellaneous applications.

BOOKS RECEIVED.

"[illegible] and Practical Brickwork. With numerous engravings and diagrams. Edited by Paul N. Hasluck. Cassell and Co. 2s. net.

"Mining Laws of the British Empire. By Charles J. Alford, F.G.S., M.I.M.M. Charles Griffin and Co., Ltd.

Annual Report of the Board of Regents of the Smithsonian Institution for [illegible]

CIRCULARS AND PAMPHLETS RECEIVED.

The Hancock Inspirator Company, New York.—An illustrated description of the Hancock globe, angle, 60 deg., and cross valves.

Kynoch, Ltd., Birmingham.—Show cards setting forth the advantages of the Kynoch suction gas plants, as recently described in PAGE'S WEEKLY.

The Shannon Limited, Ropemaker Street, E.C.—A folding circular illustrating small card systems, letter and bill files, vertical filing system, etc

Turner, Atherton and Co., Ltd. Denton, Manchester. A pamphlet giving a few expressions of opinion from users of the "Turner" electric lifts in London and the provinces.

The Simplex Steel Conduit Company, Ltd., Birmingham.—A useful list for the pocket, giving details of the latest additions to the firm's system, as well as the prices of their ordinary and screw material, in a condensed form.

J. Halden and Co., 8, Albert Square, Manchester.—Price list of permanent zinco copies. These prints resemble Indian ink drawings, and can be printed on any kind of paper or tracing cloth, when six or more reproductions are required.

The C. W. Hunt Company, New York.—A fully-illustrated pamphlet on the "Hunt" steam hoisting engines. The engines described in this catalogue are unusually massive in construction, and are especially designed for heavy duty in continuous service.

The United States Metallic Packing Company, Ltd., Soho Works Bradford.—An instructive pamphlet on the "C and I" portable electric drilling machine for bridge building and general constructional ironwork, shipbuilding, and ship repair work, locomotive and stationary engine building, tramway truck work, colliery work, and general engineering. There are numerous illustrations showing various applications of the drills.

The Lahmeyer Electrical Company, Ltd., 109–111, New Oxford Street, London, E.C.—Folding card shows at a glance, prices of the firm's new type of single-phase motors 50 cycles. These machines are all fitted with improved patent ball bearings. We have also received quotation drawing of the firm's new "Centrator" motors. The special feature of this motor is the reduction of speed, which is obtained by means of rolling friction only. It is urged that there are many instances where such a motor is specially applicable, especially with textile machines, printing presses and other machines of a like nature where space is a consideration.

Sturtevant Engineering Company, Ltd., 147, Queen Victoria Street, London.—Pamphlet No. 34 gives a careful exposition of Sturtevant mechanical draught. The firm has issued a list of the latest editions of their sectional catalogues. We quote the following for the benefit of our readers, who may obtain any of the sections mentioned on application: Forge fans, No. M. 37; Cupola fans, No. M. 15; ventilating fans, No. M. 43; Mechanical draught for boilers, No. M. 34; dust exhausting, chips, shavings, sawdust removal, No. M. 13; drying, No. M. 41; heating and ventilating, No. M 29; forges and forge plants, No. M 28; exhaust steam pipe heads, No. M 30; steam traps, No. M [illegible]; motor controlling apparatus, No. M. C.

PAGE'S WEEKLY Miscellaneous

J. POHLIG, LTD., COLOGNE.

Cheapest and most reliable System of Transport.

"OTTO"

More than 1,600 Lines at work.

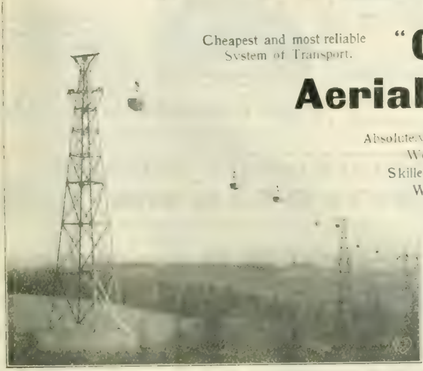
Aerial Ropeways

Absolutely Independent of Formation of Ground.
Working Unaffected by Climate.
Skilled Labour not necessary to work them.
Wear and Tear Reduced to a Minimum.

Special Department:

MODERN HOISTING AND CONVEYING MACHINERY.

Representative:
R. E. COMMANS,
6, Queen Street Place, LONDON, E.C.

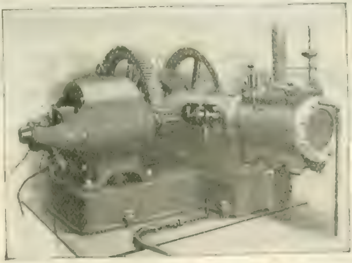


Telegraphic Address "CAULKING, LONDON."

Telephone No. 3987 GERRARD

BELT, STEAM AND ELECTRICALLY DRIVEN AIR COMPRESSORS SPECIALLY DESIGNED FOR THE OPERATION OF PNEUMATIC TOOLS.

ELECTRIC DRILLS AND HOISTS



FRANKLIN AIR COMPRESSOR [illegible] GEARED TO ELECTRIC MOTOR

BOYER RIVETING CAULKING, AND CHIPPING HAMMERS.

LITTLE GIANT, WHITELAW, AND BOYER PNEUMATIC DRILLS.

KELLER HAMMERS AND DRILLS.

Works: FRASERBURGH, N.B.

On Admiralty and War Office Lists.

THE CONSOLIDATED PNEUMATIC TOOL CO., Ltd.

General Offices: PALACE CHAMBERS, 9, BRIDGE STREET, WESTMINSTER, S.W.

Workshops and Showroom within a few minutes' walk of the Offices, where Tools can be seen in operation.

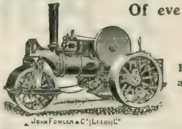
PAGE'S WEEKLY Engines, &c.

McLAREN'S
Steam Ploughs
AND TRACTION ENGINES.

Catalogues and Pamphlets mailed free on application to—
J. & H. McLAREN, Midland Engine Works, **LEEDS.**

Cable Address: "McLAREN, LEEDS."
Codes used A B C 4th and 5th Editions. LIEBERS.
Established 1876.

STEAM ROLLERS
Of every description.

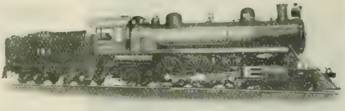

JOHN FOWLER & Co (LEEDS) Ld

Contractors to
British, German, Italian,
and Egyptian Governments
etc., etc.

JOHN FOWLER & CO. (Leeds), LTD.
Steam Plough Works, LEEDS.
Telegraphic Address: "FOWLER, LEEDS." Telephone No. 513.

BALDWIN LOCOMOTIVE WORKS.
BROAD AND NARROW GAUGE
Locomotives
SINGLE EXPANSION & COMPOUND

Mine, Furnace and Industrial Locomotives.



Electric Locomotives with Westinghouse Motors and Electric Trucks.

Burnham, Williams & Co., Philadelphia, Pa., U.S.A.
Cable Addresses: "Baldwin, Philadelphia": "Sanders, London." General Agents: SANDERS & CO., 110, Cannon St., London, E.C.

COKE OVENS
AND THEIR HISTORY.

Price 1/6 Post Free. Seventeen Whole Page Plates.

CONTENTS.

Introduction
The Bee-Hive Coke Oven.
C. Otto & Company's Bee-Hive Coke Oven, of 1883
Key's Bee Hive Coke Oven 1903
Construction of the Modern Coke Ovens
The Simons-Carves Coke Oven
The Semet-Solvay Coke Oven.
Coppée's Coke Oven
Gustav Hilgenstock's Coke Oven
The Otto Hoffmann Coke Oven
The Otto Hilgenstock Coke Oven
Huessener's Coke Oven
Franz Brunck's Coke Oven
Koppers's Coke Oven
Von Bauer's Coke Oven
Collin's Coke Oven
Poetter's Coke Oven.
The By Product Recovery Plant for Extracting Tar and Ammonia
The Products of the By Product Recovery Coke Oven
The Value of the By Products of Coke Ovens
List of the Principal Patents Granted from 1820 to 1903

BY

PAUL J. MALLMANN, M.A.,

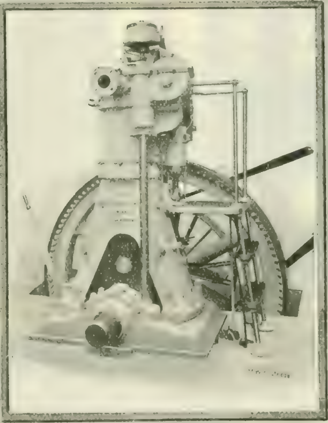
Civil and Consulting Engineer and Coke Oven Expert,

110-118, Victoria Street, Westminster, London, S.W.

PAGE'S WEEKLY Oil Engines

THE MIRRLEES WATSON CO. LTD.
GLASGOW.
LONDON OFFICE: 158 GRESHAM HOUSE, OLD BROAD STREET, E.C.

THE
DIESEL
OIL
ENGINE



IT IS THE MOST ECONOMICAL ENGINE MADE AND IS MORE RELIABLE THAN ANY OTHER OIL ENGINE.

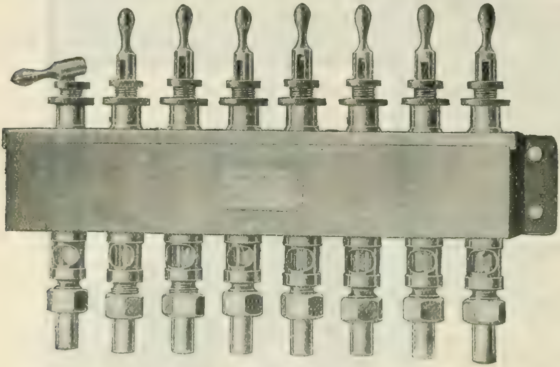
PAGE'S WEEKLY Oil Boxes and Lubricators

HUNT & MITTON, ENGINEERS, BRASSFOUNDERS, &c.,

Crown Brass Works, Oozells Street North,

Birmingham.

Telephone No.: 394.
Telegraphic Address: "MITTON, BIRMINGHAM."



Cast Brass Oil Box, No. 1055.

Makers of

CAST BRASS OIL BOXES.

SHEET BRASS OIL BOXES.

Fitted with Sight Feeds or Cocks

SIGHT FEED LUBRICATORS.

Steam Cylinder Lubricators.

DISPLACEMENT LUBRICATORS.

Solidified Oil or Grease Cups.

STAUFFER LUBRICATORS,

&c.

Sole Makers of

Holliday's Patent Oil Box.

This box is made of Polished Sheet Brass, and is fitted with two or more feeds as required, each feed may be worked separately or all at one time.

OIL BOXES AND LUBRICATORS MADE TO CUSTOMER'S OWN REQUIREMENTS.

Holliday's Oil Box, No. 1054.

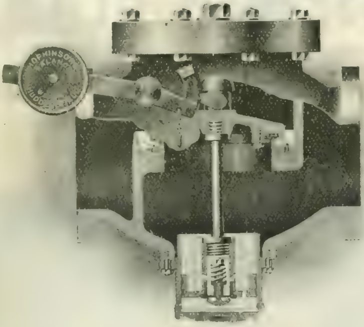
Hunt & Mitton,
Oozells Street North,
BIRMINGHAM.

. . Makers of all kinds of .

OIL BOXES and LUBRICATORS, STEAM FITTINGS, ENGINE and BOILER MOUNTINGS, HYDRAULIC FITTINGS, PRESSURE GAUGES, &c.

PAGE'S WEEKLY Valves & Boiler Mountings

Specify Hopkinson's Patent Safety Boiler Mountings.



HOPKINSON'S

"SILENT"

AUTOMATIC

EXHAUST VALVE.

Specify Hopkinson's Fig. No. 7050

WRITE FOR LISTS—

J. HOPKINSON & Co., Ltd., HUDDERSFIELD.

For the information of Readers and Subscribers, we beg to announce that

Page's Weekly

is published half-yearly, in two volumes, as follows

(1) From the first week in January to the last week in June.

(2) From the first week in July to the last week in December inclusive.

The [illegible] bound Volumes are

	s.	d.
Half Morocco	20	0
Green Cloth	15	0

Clun House, Surrey Street,
Strand, London, W.C.

The **"SHAW"** Patent Steam Valves . .

With Renewable Seats, Interchangeable Concentric Valve, Compound Packing to Spindle, Special Metal, and High-Class Workmanship.

The "SHAW" Patent Parallel Slide Valve is the Acme of Simplicity and Durability.

Try Them ! Sent on Approval.

☞ *Write for particulars of these and other Specialities for High Pressure Steam*

JOSEPH SHAW, B Dept., Albert Works HUDDERSFIELD.

Hepton & Sons,

LEEDS.

Wheel Valve.

Special Net Price.

Steam Cocks & Valves.

Wrought Iron Tubes.

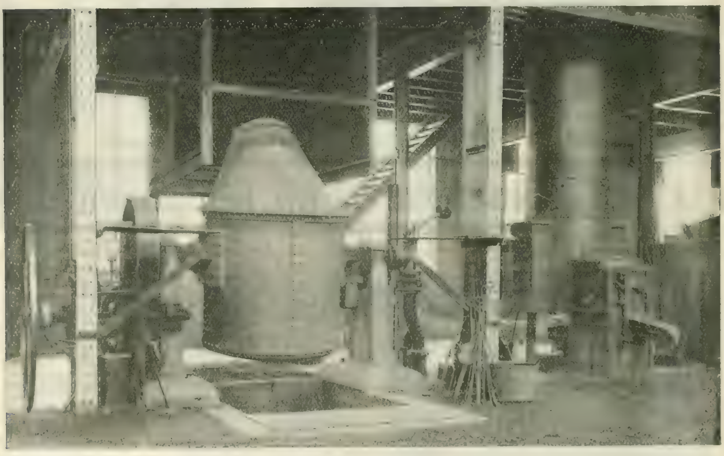
SMALL BESSEMER PLANT

(UNCKENBOLT SYSTEM)

For the Production of Steel and Iron Castings of Highest Qualities,

as in use at the

North German Lloyd Repairing Works, Bremen.



REFERENCES:—

THE STETTIN VULCAN CO. STETTIN-BREDOW
THE WESER CO., LTD., BREMEN.
THE BURGEOISE CO., LTD., BRUGES
NORTH GERMAN LLOYD REPAIRING SHOPS, BREMEN
FREDERICK KRUPP, LIMITED, ESSEN.

Cost of Plant and License depends on the Particular Requirements of the Works.

For full Particulars and permission to see Plants in Operation, apply to—

Paul J. Mallmann, M.A.,
110-118, Victoria Street, LONDON, S.W.

PAGE'S WEEKLY Bennis Elevators

"BENNIS" CONVEYORS & "BENNIS" ELEVATORS

SAVE

TIME.
ENERGY.
MONEY.
TEMPER.

Bennis Elevators and Conveyors handle all CLASSES OF MATERIALS,
AND
CAN BE INSTALLED ANYWHERE AND EVERYWHERE.

COVENTRY BARGE ELEVATOR

"BENNIS" ELEVATING AND CONVEYING PLANT is at work in

Power Stations
Collieries
By the Waterside
Granaries
Gas Works
Warehouses
Factories
Breweries
Mills, &c.

Transporting Hundreds of Thousands of Tons of Material.

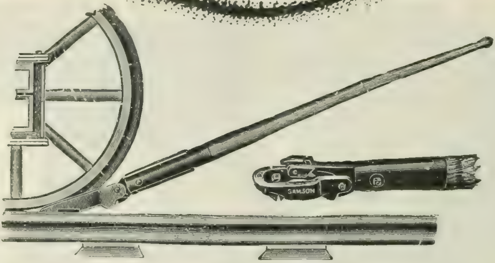
Saving and Conserving everywhere.

BENNIS, LITTLE HULTON, BOLTON.

PAGE'S WEEKLY Railway Pinch Bars

"SAMSON"

PINCH BARS



Used by the chief British Railways and a large number of those abroad.

SPECIALLY USEFUL FOR COLLIERIES AND FIRMS WITH SIDING CONNECTIONS, AND IS A GREAT LABOUR-SAVING TOOL WHERE WAGONS OR LOCOMOTIVES REQUIRE MOVING SHORT DISTANCES.

SAMSON & CO.,

Garforth, near LEEDS.

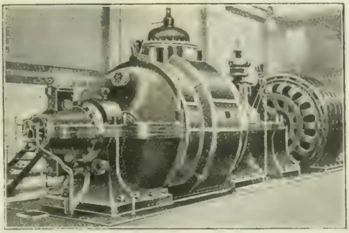
Telegrams: "SUTTON, GARFORTH."

The most efficient prime mover is a

Westinghouse Steam Turbine.

Sound
Mechanical
Design.

Absolutely
Smooth
Running.



One of the Westinghouse 4,700-H.P. Turbo-Generators at the Neasden Power Station of the Metropolitan Railway, London.

**The British
Westinghouse
Electric and Mnfg. Co., Ltd.**

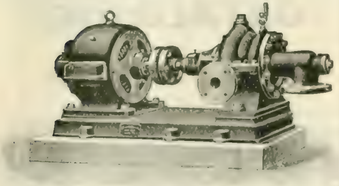
**London and
Manchester.
Branch Offices:
In all large Towns.**

HIGH LIFT

Centrifugal Pumps

MOST SUITABLE AND MOST ECONOMICAL PUMPS
FOR ALL ELECTRICAL AND INDUSTRIAL SERVICES.

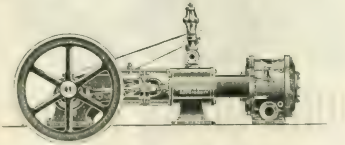
OUR SPECIALITY.



Made for any capacity for all lifts, with highest efficiency, specially for direct coupling with Electromotors, also high-speed Electrical Plunger Pumps for all services.

WEISE & MONSKI,

HALLE, O.S. (Germany).



**Air Compressors,
Boring Tools,
and Pumps,**

BY

JOHN Z. THOM,

Canal Works,
PATRICROFT, nr. MANCHESTER.

Contractor to H.M. Government.

[illegible]

PAGE'S WEEKLY Electrical Apparatus, &c.

AIR OUTLET
GIBBS PEERLESS DUST SEPARATOR & COLLECTOR
DUST CONVEYER PIPE

JOHN GIBBS & SON'S

Ventilating and Dust Collecting Plant, for Polishing and Grinding Shops, etc., showing our "Peerless" Apparatus for removing dust direct from the polishing bobs before it has had time to spread about the room, together with our "Peerless" Dust Separator for collecting the dust, and so preventing it causing trouble by escaping on to the roofs of neighbouring buildings, stopping gutters, etc. Of great service where the dust is of value, as in woodworking machinery and mills where the produce is saleable, and will soon pay for the first outlay.

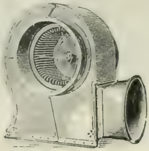
Messrs. JOHN GIBBS & SON will be pleased to arrange schemes and furnish full particulars to suit the circumstances of each special case on application.

80, JUKE STREET, LIVERPOOL.

TELEGRAMS
Ventilation Liverpool

TELEPHONE
No 2579 Royal

Highest Award, Grand Prize, St. Louis Exhibition, 1904



"SIROCCO" FANS,
For Induced Draught on Boilers, Heating, Cooling, Ventilating, etc.
DAVIDSON & CO., LTD.,
"Sirocco" Engineering Works, Belfast

13, Victoria St., Westminster, LONDON, S.W.
37, Corporation St., MANCHESTER.
115, Hope St., GLASGOW.

Sole Continental Representatives: Messrs. WHITE, CHILD, & BENEY, Ltd.,
62 63 Queen St., Cheapside, LONDON, E.C.

A POSTCARD
WILL ADD TO
Your Office Library
A NEW AND COMPLETE
CATALOGUE
OF
Drawing and Surveying Instruments,
Scales, Tapes, Inks, Colours,
Pencils, Cabinets, Papers, etc.

176 PAGES. 300 ILLUSTRATIONS

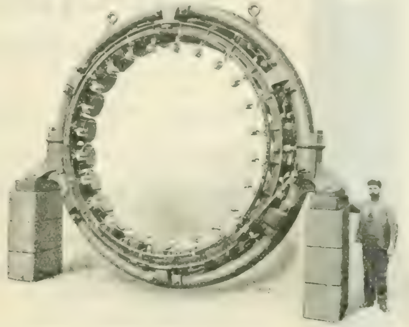
Address it to:
B. J. HALL & Co.,
39, Victoria Street,
LONDON, S.W.

PAGE'S WEEKLY Electrical Apparatus

ELECTRICAL MACHINERY

OF ALL DESCRIPTIONS CAN BE OBTAINED FROM

ERNEST SCOTT & MOUNTAIN, LTD., NEWCASTLE-ON-TYNE.



This Illustration shows a Magnet Ring, and Brush Gear of a 600-kw. continuous current Generator.

This picture represents an Electrical Engineering Works in Yorkshire, which is specially laid out for the manufacture of Dynamos, Motors, Switches, and Switchboards. Everything is of the best; and prices are the lowest possible, consistent with [illegible] material and workmanship.

Note the Name and Address:

T. W. BROADBENT,
Victoria Electrical Works,
EAST PARADE, HUDDERSFIELD.

Write for Prices and Particulars
OF OUR
NEW "STANDARD"
MACHINES.

They will interest you

Dynamos "P.D.M." Motors

BEST MATERIAL WORKMANSHIP AND DESIGN

PHŒNIX DYNAMO MFG. CO., Ltd.,
Thornbury Works, BRADFORD.
London Office: [illegible] Victoria St., Westminster, S.W.
[illegible]

AKTIENGESELLSCHAFT
Mix & Genest
Telephone and Telegraph Works
BERLIN, W.
INSTRUMENTS OF BEST AND APPROVED CONSTRUCTION.
Illustr. Catalogues supplied to the TRADE only

Telephone Apparatus
For Domestic Use, Town Lines and Long Distances, with Battery and Magneto Call.

Central and Multiple
. . Switchboards.

Electric Bells, Indicators,
Fire Alarms,
Water Level Indicators.

ALL ACCESSORIES AND OTHER MATERIAL

PAGE'S WEEKLY Miscellaneous

Electric Impulse Clocks

NO WINDING UP.

For ACCURATE TIME-KEEPING

In all the various departments of large establishments. Suitable for

TURRET, WAREHOUSE, OFFICE, PRIVATE RESIDENCE,

Or any other position.

Perfect and Uniform Time
At all Points.

PATENTEES AND SOLE MAKERS:-

GENT & CO., Ltd.
FARADAY WORKS,
LEICESTER.
And 3a, Upper Thames Street, LONDON, E.C

NO ATTENTION NEEDED.

SEND FOR CATALOGUE C.P.

CELLULOID SLIDE RULES.

UNIVERSAL DRAFTING MACHINE.

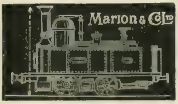
Piece Work, Balance and Premium Calculator.

Drawing Instruments.

Send for Pamphlets.

JOHN DAVIS & SON
(Derby), LTD.
30, All Saints Works, DERBY, &
36L, Camomile Street, LONDON, E.C.

PLAN-COPYING PAPER & LINEN.



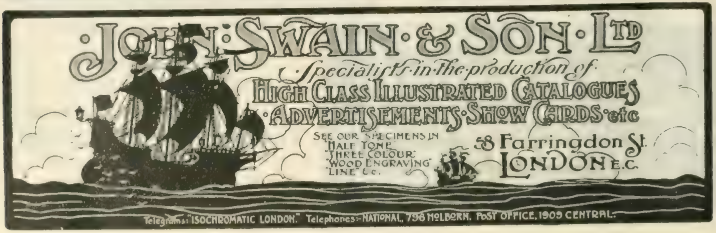
MARION'S world-renowned PLAN COPYING PAPERS and LINENS and LINEN-BACKED PAPERS, giving Blue, Black, and Brown Lines on White Ground, or vice versa.

THE FINEST ON THE MARKET

FOR ENGINEERS & ARCHITECTS.

Descriptive Booklet, Specimen Prints, and Price List post free on application.

MARION & CO., LTD.,
22 and 23, Soho Square, LONDON, W.



JOHN SWAIN & SON LTD
Specialists in the production of
HIGH CLASS ILLUSTRATED CATALOGUES ADVERTISEMENTS SHOW CARDS etc
SEE OUR SPECIMENS IN
HALF TONE
THREE COLOUR
WOOD ENGRAVING
LINE &c.
58 Farringdon St.
LONDON E.C.
Telegrams: "ISOCHROMATIC LONDON." Telephones:-NATIONAL, 798 HOLBORN. POST OFFICE, 1909 CENTRAL.

IT IS

TEN TO ONE !!!

If you write for a Descriptive Booklet and Price List of

The "Dey" Time Register

To **HOWARD BROS.,**

The Proprietors,

100b, Queen Victoria Street, London, E.C.,

Or, Head Office, **40, Paradise Street, Liverpool,**

AND LOOK INTO THE QUESTION of Time and Cost Keeping, you will find you are **LOSING MONEY** where you could **SAVE** it by using the **"DEY" TIME REGISTER.**

PAGE'S WEEKLY Railways

NORTHERN RAILWAY OF FRANCE

AND

SOUTH EASTERN & CHATHAM RAILWAYS.

FREQUENT and RAPID COMMUNICATION BETWEEN LONDON and PARIS.

SHORTEST SEA PASSAGE

(ONLY ABOUT SIXTY MINUTES).

FIVE QUICK SERVICES DAILY, as under :—

Via DOVER AND CALAIS.

Depart. from London		Arrival in Paris
†* 9.0 a.m. (Charing Cross Station)	For PARIS only	4.45 p.m.
	For Intermediate Stations ...	6.5 p.m.
† 11.0 a.m. from	Victoria Station	6.45 p.m.
‡ 9.0 p.m.	Charing Cross Station ...	5.50 a.m.

Depart. from Paris.		Arrival in London
† 8.25 a.m.	For Intermediate Stations	4.55 p.m. Charing Cross Station
†* 9.50 a.m.	For CALAIS only	
†* 12 noon	... ...	7.5 p.m. Victoria Station
‡ 8.40 p.m.	... Intermediate Stations	5.40 a.m. Charing Cross Station.

Via FOLKESTONE AND BOULOGNE.

Depart. from London.		Arrival in Paris.
‡ 10.0 a.m.	from Charing Cross Station ...	6.5 p.m.
†* 2.20 p.m.		9.15 p.m.
‡ 2.20 p.m.		11.25 p.m.

Depart. from Paris.		Arrival in London.
‡ 8.25 a.m.	Intermediate Stations	3.45 p.m. Charing Cross Station
‡ 2.40 p.m.		10.45 p.m.
†* 4.0 p.m.	For Boulogne only .	

† 1st and 2nd Class only. ‡ 1st, 2nd, and 3rd Class. * Restaurant Car between Paris and Calais or Boulogne, and *vice versâ*

⁂ First-class Hotel and Restaurant at the Gare du Nord, Paris, and at Calais Maritime Station. Luncheon Baskets obtained at fixed prices.

The 2.20 p.m. departure from Charing Cross is the fastest connection between London and Bâle for Switzerland and Italy, *viâ* the Gothard Route. Through Corridor Trains and Restaurant and Sleeping Cars.

South Eastern & Chatham Railway.

THE CONTINENT

Four Royal Mail Routes

VIA

DOVER CALAIS.	FOLKESTONE BOULOGNE.	DOVER OSTEND.	QUEENBORO FLUSHING.

LONDON-PARIS IN LESS THAN SEVEN HOURS.

Five Services Daily in Each Direction.

NEW EXPRESS AFTERNOON DINING CAR SERVICE.

Daily (Sundays included), via FOLKESTONE and BOULOGNE.

	P.M.		P.M.
CHARING CROSS - - - - - - - - - -	2.20	PARIS - - - - - - - - - - - - -	4.0
PARIS - - - - - - - - - - - - -	9.15	CHARING CROSS - - - - - - - - - -	10.45

Mail Route *via* Dover and Ostend.

Three Express Services Daily in Each Direction.

Flushing Royal Mail Route to Germany, etc.

Two Services Daily in Each Direction.

For Full Particulars see S.E. & C.R. Continental Time Tables, price 3d.

VINCENT W. HILL, *General Manager.*

PAGE'S WEEKLY Printing, &c.

Arthur Stafford & Co.

Read what the "Caxton Magazine" the Official Organ of the Printing and Kindred Trades, says about our Printing.

"An illustrated Catalogue printed by MESSRS ARTHUR STAFFORD & CO, Denton, is a decidedly up-to-date specimen of typography and half-tone printing, and reflects the highest credit on the producers."

"An extremely tasteful piece of work, perfectly produced."

HIGH GRADE PRINTERS

of Engineers' Catalogues, &c, at the Best Prices.

Modern Printing for Modern People.

Central Printing Works, DENTON,
MANCHESTER.

***Match & Match Box* MACHINERY.**

Sole Speciality since establishment in 1855 of

A. ROLLER, Engineer,

BERLIN N.20, GERMANY.

Cable Address:
"Phosphoros, Berlin."

Catalogues and Estimates for Complete Plants Free on Application.

REFERENCES TO MATCH MANUFACTURERS ALL OVER THE WORLD.

RUBBER STAMPS
and ACCESSORIES —
DATING, TIMING & NUMBERING STAMPS

RUBBER STAMP COMPANY
The Commercial Stamp Makers
BIRMINGHAM.

SPECIAL QUICK DRYING AND OPAQUE INKS.

BUSINESS SYSTEMS.

Cut out this Coupon and indicate in the list below what systems you are interested in, then send to
P—81.

ROCKWELL-WABASH CO., Ltd.,
69, Milton Street, London, E.C.,
who will send you Information Forms relating to same.

1. Factory Costs
2. Stores Ledgers
3. Perpetual Card Ledgers
4. Quotations—Given
5. Quotations—Received
6. Advertising Records for Advertisers
7. Advertising Records for Agents
8. Advertising Records for Publishers
9. Staff Register
10. Customer's Lists
11. Addressing Lists
12. Follow-Up-Systems—Sales
13. Follow-Up-Systems—Overdue Accounts
14. Credit Ratings
15. Shareholders' Register
16. Filing Catalogues
17. Filing Correspondence
18. Filing Invoices
19. Pattern Records
20. Drawing Records
21. Order Systems
22. Doctors, Dentists, and Oculists
23. Membership Records
24. Insurance Records for Companies
25. Insurance Records for Brokers
26. Insurance Records for Agents

PAGE'S WEEKLY Miscellaneous

MAGNESIA COVERINGS
FOR
STEAM PIPES & BOILERS.

Send for Descriptive Pamphlet to the Sole Manufacturers in Europe.

MAGNESIA COVERINGS, Ltd.,
WASHINGTON STATION
COUNTY DURHAM.

Telegrams: "CHEMICAL," WASHINGTON STATION.
Nat. Telephone: No. 1373 NEWCASTLE.

AGENTS:—

HOBDELL, WAY & CO., LTD.,	63, CRUTCHED FRIARS,	LONDON, E.C.
THOMAS ANDERSON,	53, DERBY ROAD,	LIVERPOOL.
HICKSON'S LTD.,	38, WELL STREET,	BRADFORD.
PETER FERGUSON,	19, ROYAL EXCHANGE SQUARE,	GLASGOW.

W. C. HOLMES & Co.,
ENGINEERS.
Sole Makers of the . .
"WESTERN" DOUBLE FACED VALVE.

SPECIALITIES:—
ROOFS,
BRIDGES,
GIRDERS,
STRUCTURAL
IRON WORK,
TANKS, &c.

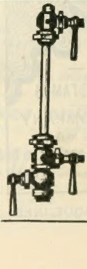
Works—
Huddersfield.

London Office—
11, Victoria
Street, S.W.

TUBES
for **SUPERHEATERS**
Our Speciality
Send for particulars and prices.

Weldless
Steel and Iron
Tubes, Steam Pipes,
Hydraulic Tubes, &c.

TUBES Ltd.,
Birmingham.



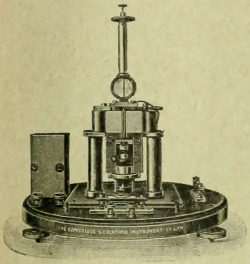
J. B. TREASURE & Co.
Excelsior Fire-Polished
GAUGE GLASSES,
LUBRICATORS,
INDIA-RUBBER WASHERS,
&c., &c.
Vauxhall Road, Liverpool.

THE NEW

DUDDELL INSTRUMENT

THE DUDDELL PATENT THERMO-GALVANOMETER

For measuring Minute Currents and Potential Differences.



The principle of the Instrument consists of a Resistance heated by the Current to be measured, the heat from the Resistance falling on the Thermo-Junction of a Boy's Radio-Micrometer.

Heaters easily Interchangeable.

ADVANTAGES:

Accurate Measurement of Currents of infinitely small range and any frequency.

Wide variability of resistance.

Dead-beat, unaffected by Magnetic Fields, and without self-induction or capacity.

Will measure Wireless Telegraphy, Telephone, X-Ray and Secondary Medical Induction Coil Currents.

Invaluable alike in Scientific Research and for Commercial Purposes.

Price of Thermo-Galvanometer with 4 and 100 ohm Heaters, **£15 10s.**

Additional Heaters: From 4—100 ohms, **7s. 6d.** each ; 400 ohms, **10s. 6d.** each ; 1,000 ohms, **12s. 6d.** each.

Write for Full Descriptive Pamphlet 38 P to—

THE CAMBRIDGE SCIENTIFIC INSTRUMENT Co., Ltd.,
Cambridge, ENGLAND.

ENCLOSED MOTOR.

JOSEPH BOOTH & BROS.
LTD.,

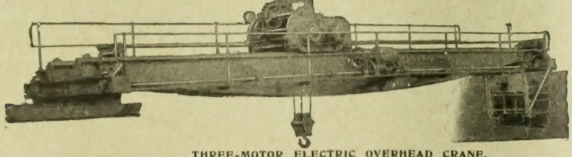
Electrical and Mechanical Engineers,

Telegrams: "CRANES, RODLEY." Rodley, LEEDS.

Makers of Dynamos, Motors,

Electric & Steam Cranes.

Inquiries Solicited.



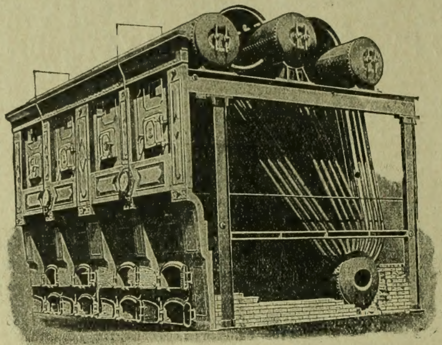
THREE-MOTOR ELECTRIC OVERHEAD CRANE.

Cranes. Capstans. Winding Machines.

Makers to Home, Colonial, and Foreign Governments, and all Leading Firms.

THE STIRLING BOILER CO.,

LIMITED.



Head Office and Works:—
MOTHERWELL, N.B.

CIRCULATION PERFECT.

CLEANING SIMPLE.

FEW JOINTS.

London Office:
25, Victoria St.,
Westminster, S.W.

CONTRACTORS TO HIS MAJESTY'S AND OTHER GOVERNMENTS.

JAMES FAIRLEY & SONS,

General Steel Manufacturers, and SPECIALISTS in . . . TOOL STEELS

Invite attention to their Unrivalled Self-hardening Steel.

FAIRLEY'S SELF-HARDENING TOOL STEEL

FOR HEAVY CUTS AT HIGH SPEEDS.

Is considered to be the HARDEST and TOUGHEST Steel yet made (although the cheapest in the Market). Small samples free to approved buyers.

NOTE.—JAMES FAIRLEY & SONS' WORKS (Bramall Lane, Sheffield, and Mill Street Forge and Rolling Mills Birmingham) are merely Branch Departments, and

All Communications should be addressed to the Head Offices:—

OLD MINT, SHADWELL STREET, BIRMINGHAM.

John Purden & Sons,

LAMBHILL FORGE,
BY MARYHILL
GLASGOW.

On Admiralty List.

Makers of Marine and other Forgings, rough turned or finished. Tail-End Shafts, Built Rudders and Crank Shafts finished complete.

Telegrams: "FORGINGS, GLASGOW."
National Telephone: No. 34 MARYHILL.

Printed for the Proprietors by SOUTHWOOD, SMITH & CO., LIMITED, 6, 7, 8, 9, Plough Court, Fetter Lane, London, E.C.; and Published at Clun House Surrey Street, Strand, London, W.C.